PETROLEUM PROCESSING

including Petrochemical Processing Section

DECEMBER 1952

Better Way to Gas-Free Tanks

Pull the vapors up from the bottom through flexible tube—p. 1778

Speed-up for API Project 44

How punched cards improve handling basic hydrocarbon data—p. 1769

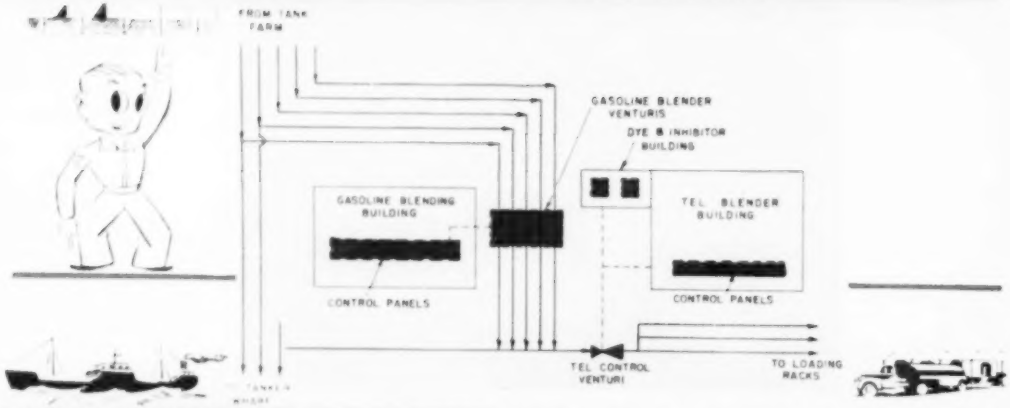
Status of Petrochemical Expansion

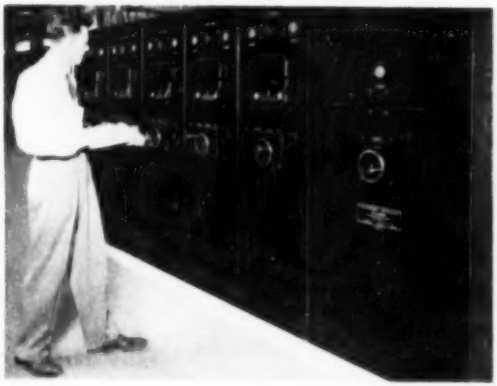
Over $800 million authorized to meet needs on 22 products—p. 1793

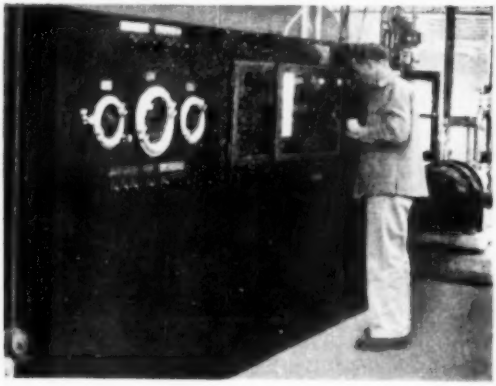
First Pyridines Plant on Stream

Will bolster supply for this critically short coal tar byproduct—p. 1802

Blueprint for continuous blending of gasoline; base stocks and TEL







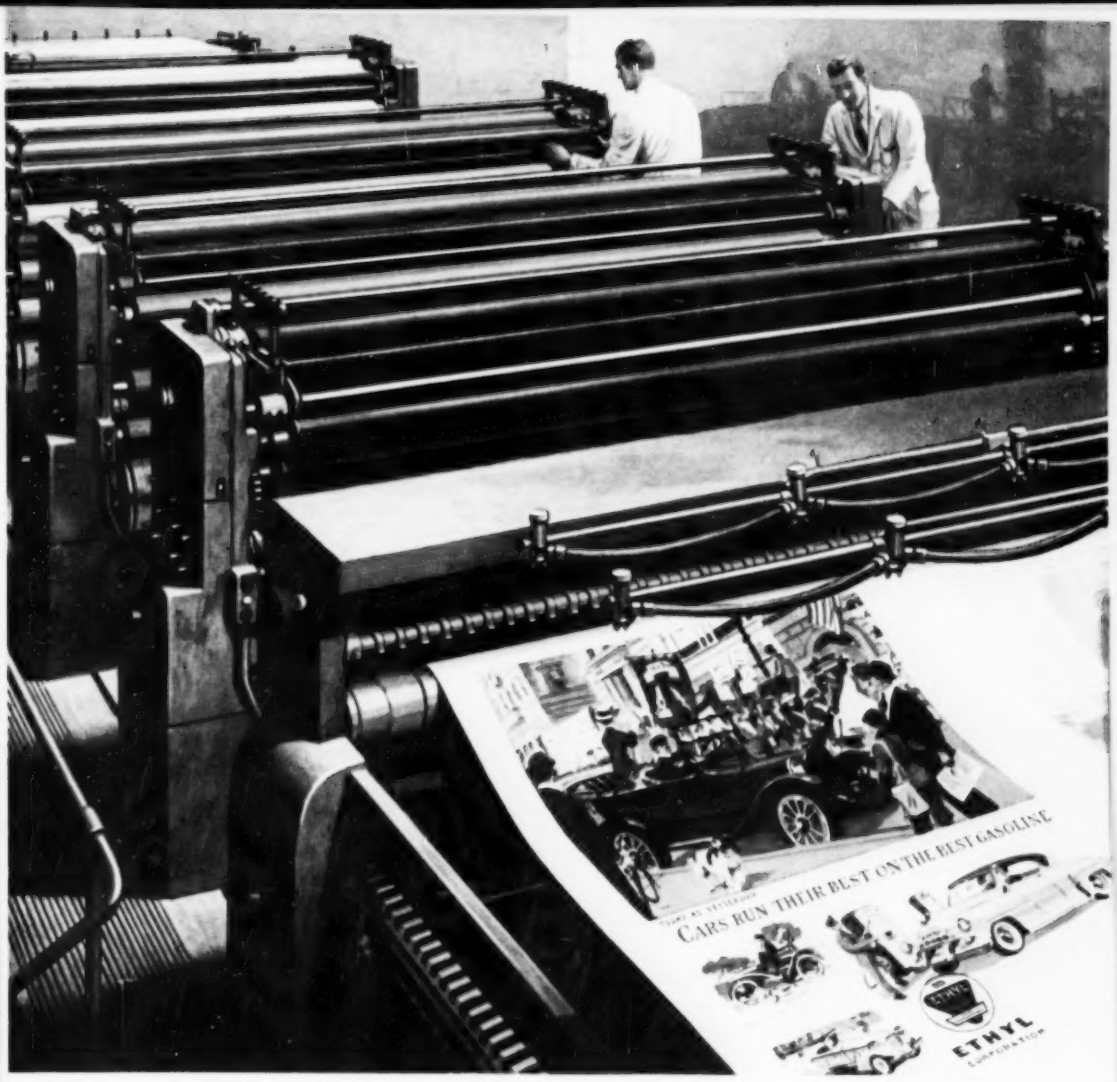
"%Proportioneers, Inc."% new differential control method continuously blends base stocks and adds inhibitors, dyes and TEL to produce regular and premium gasolines on a direct "tank to tanker" basis *without intermediate storage*.

This exclusive differential control system, field proven in many successful installations, integrates flows of base stocks to produce a product of uniform characteristic regardless of variations in line pressures or flows. The "%Proportioneers"% method makes the blending process continuous and automatic assuring high accuracy in the blending of components and strict adherence to formula in proportioning even minute quantities of additives. Auxiliary tanks, piping, circulation pumps and mixing equipment are eliminated — with a resultant saving in floor space, power and equipment costs. The "%Proportioneers"% system offers new speed, flexibility and economy in the production of blends, improving the product and the competitive position of the producer. Ask for recommendations and descriptive literature.

% PROPORTIONEERS, INC. %

Write to "%PROPORTIONEERS, INC. 447 Harris Ave., Providence 1, R. I.

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.



Printer's ink—an important ingredient of "Ethyl" gasoline

The composition of "Ethyl" gasoline has changed over the years as new refining processes have been developed. But printer's ink has always been a basic ingredient.

Starting in 1924, Ethyl advertising and promotion helped establish the premium gasoline market—a market which has brought millions of dollars of added income annually to the petroleum industry.

Today millions of motorists are buying "Ethyl" gasoline. But markets must be continuously developed. Every year millions of people come of driving age.

Continued on next page

ETHYL
ETHYL CORPORATION

Printed in U. S. A.

Printer's ink—an important ingredient of "Ethyl" gasoline

Continued from preceding page

These people are too young to have seen the 1927 or 1928 Ethyl advertising. They, as well as present users, must be sold this year, next year and the year after that. That's why Ethyl advertising is a continuous year-in and year-out effort and has been for 28 years.

This year, Ethyl's "old car" campaign is appearing in national magazines reaching 48 million people every month. In addition, during the peak driving season, television and special drive-in movie films demonstrate to millions of car owners why it's smart to use "Ethyl" gasoline. But whatever its form, the important thing is that Ethyl advertising is working for you.

National advertising is one of the important reasons why Ethyl is first in antiknock service.

ETHYL CORPORATION
NEW YORK 17, NEW YORK

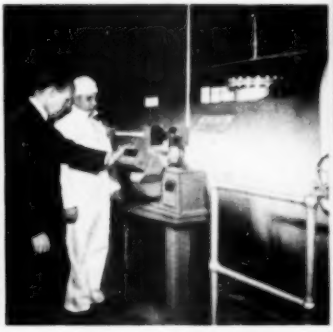
Ethyl service is backed by 29 years of antiknock experience

RESEARCH

SALES HELPS

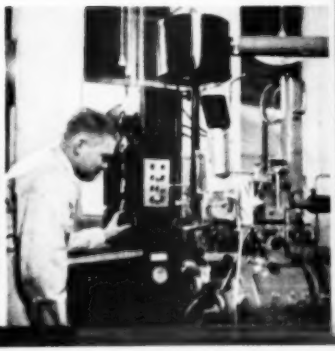
FARM SERVICE

ROAD TESTING



SAFETY SERVICE

GASOLINE TESTING



The only evidence of Lummus at this stage of the project is a team of 'dozers doing initial clearing. But soon it will be a completely-integrated petroleum refinery . . . or a modern chemical plant . . . or petroleum chemical units employing the newest and best processing concepts.

Meanwhile, the earth-movers are prophetic. They signal the application of Lummus' complete one-contract, one-responsibility engineering service from initial studies through acceptance run. And the trademark they wear means that *every* Lummus man who has a hand in the project has a strong and steady desire to make *this* the best job ever turned out by the company.

Isn't this the spirit, quality and depth of technical talent you'd like to engage for your next project? You'll find it in abundance at Lummus. If you use it, you put into force the strongest guarantee of a modern, flexible, efficient, profitable plant.

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Enables use of full tank capacity without increasing shell height. Cuts out 75% of evaporation losses and fire hazard when tank is full.

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Stops wind from sucking valuable vapors out of slot. Saves 50% of the evaporation losses suffered by tanks with a single seal. Standard equipment with Wiggins Floating Roofs for extra savings.

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For full information on how to reduce vapor losses and maintain the quality of stored petroleum products, write for the Wiggins Hi-Disk Floating Roof Bulletin.

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PETROLEUM PROCESSING

Covering petroleum research and the design, management, operation and maintenance of plants processing hydrocarbon materials into fuels, lubricants and chemicals

December, 1952
Vol. 7, No. 12

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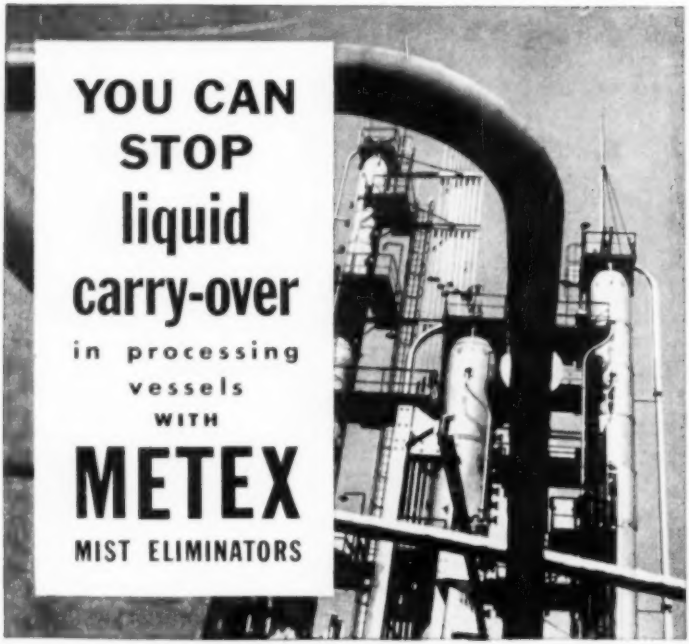

YOU CAN STOP liquid carry-over

in processing vessels WITH

METEX

MIST ELIMINATORS

The unusually high efficiency with which these *knitted* wire mesh units remove the liquid entrainment that occurs in a wide variety of refining and processing operations has enabled engineers to:

1. Improve product quality and eliminate reruns.
2. Prevent contamination in subsequent operations.
3. Recover valuable products previously lost.
4. Operate existing equipment at higher capacities.
5. Design new equipment with smaller dimensions.
6. Achieve more economical processing of lower grade materials.
7. Secure longer "on-stream" periods by removing corrosive liquids.
8. Prevent air pollution by objectionable liquids.

METEX Mist Eliminators can be used *wherever* the problem of liquid entrainment exists. By effecting complete removal of liquids, Mist Eliminators contribute to more efficient and economical processing in such vessels as:

VACUUM PIPE STILLS	EVAPORATORS	COMPRESSORS
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KNOCK-OUT DRUMS	SCRUBBERS	STEAM DRUMS

Get the full facts on METEX Mist Eliminators

Write for bulletins giving detailed information — including limiting velocities, pressure drop, efficiencies, etc.

METAL TEXTILE CORPORATION

KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY

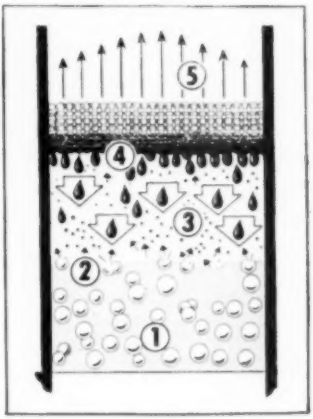
Main Office & Plant, Roselle, New Jersey Canadian Plant, Hamilton, Ont.

PADS OF KNITTED WIRE MESH WIPE OUT LIQUID ENTRAINMENT

Pads of uniform density, made from multiple layers of knitted wire mesh, have proved exceptionally effective in removing liquid entrainment from gases in a wide range of refining and processing operations.

The pad is placed inside a vessel above the liquid level. Its construction provides a multiplicity of unaligned, asymmetrical openings with unusually large wire-surface area. It is impossible for a gas to pass through the pad without continually changing direction; yet the high free volume—97 to 98%—minimizes restriction and pressure drop.

METHOD OF OPERATION



When a gas is generated in or passes through a liquid (1), it carries with it, as it bursts from the liquid surface (2), a fine spray of droplets of entrained liquid. These droplets are carried upward by the rising gas stream (3).

As the gas passes through the pad, the droplets impinge on the extensive wire surface (125 square feet of area per cubic foot of pad volume). The droplets coalesce on the wire surface to form large drops of liquid which break away (4) from the wire mesh and fall back against the gas stream. The gas (5) passes on, freed from liquid entrainment.

AVAILABILITY

The pads, which are known as METEX Mist Eliminators are made by Metal Textile Corporation, 631 East First Avenue, Roselle, N. J. A bulletin giving detailed information is available on request from the manufacturer.

PETROLEUM PROCESSING

Publisher's Page

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Another Tool for the Technical Man

There's a surprise in store for some of you this month—you might even call it a Christmas Bonus.

For the first time in many moons our annual subject and author index has been compiled even before this last issue of the year was mailed off to you. (No crystal ball reading; we did it from page proofs.) Right now the 1952 index is in the printer's hands, and your copy—if you want one—will be sent to you in the next week or so.

And if you want a copy, all you have to do is ask. You don't even have to write us a letter or pay the postage. As the advertising brethren say—"Just fill out the coupon and mail it in!" Your coupon is the "What's New" reply card you'll find between pages 1840 and 1841 in this issue. The code number for requesting a copy of the index is "35."

Getting together an annual index for a technical publication like PETROLEUM PROCESSING is quite a job, as you who keep your own personal indices on data of particular interest to you well know. There are something like a thousand items in the course of 12 issues of PETROLEUM PROCESSING that have to be indexed.

Even bigger than the physical job, however, is the problem of properly pegging each item under appropriate subjects so that you can ferret out the information you want without being a mind reader. For example, the lead feature article in this issue on the work of API Research Project 44 has been indexed under five subjects: American Petroleum Institute, Design Data, Information Services, Properties of Hydrocarbons, and Research.

There's an easier way to index, of course, and one that some publishers employ. They merely group items together under a few general headings. But to our way of thinking an index is a working tool for you who bind or file your copies of PETROLEUM PROCESSING. It's going to be of value and help to you only to the extent that it's complete and easy to use.

If you haven't gotten the index habit, give it a try. Circle that No. 35 today and get your copy. It's free, too.

V. B. Guthrie

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National Petroleum News
The weekly oil marketing magazine, covering news, prices, transportation, storage, merchandising

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A daily independent oil-news reporting service issued from New York, Cleveland and Houston

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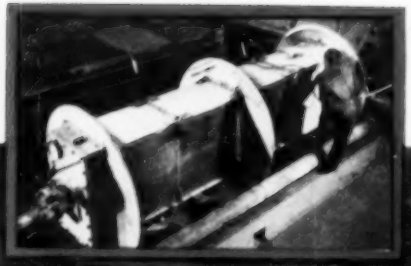
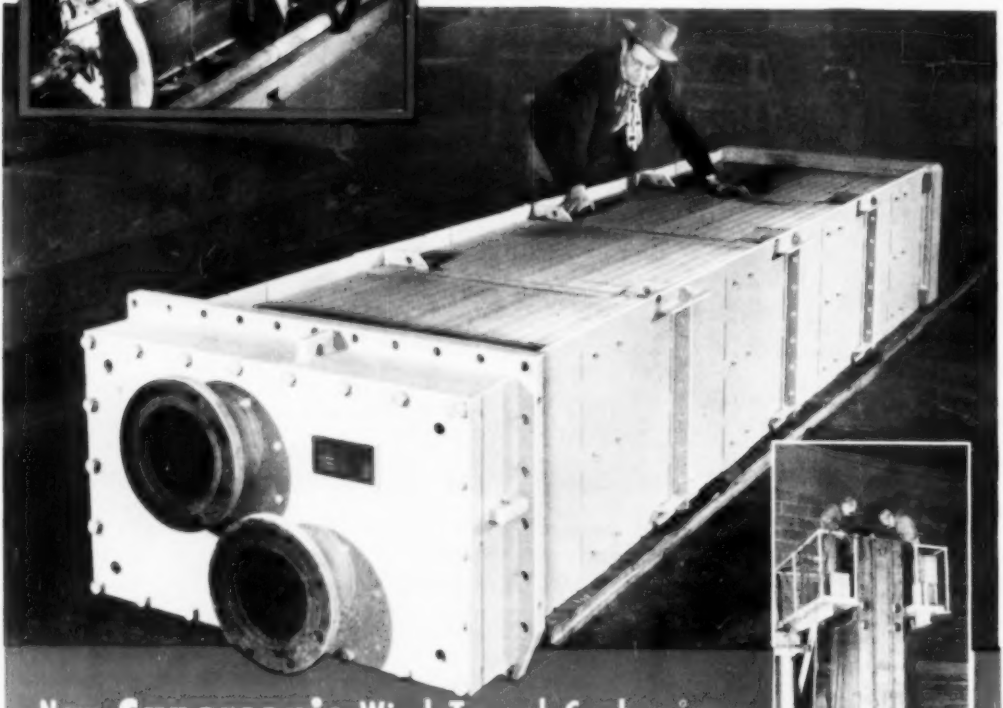
A daily independent oil-price reporting service issued from New York, Cleveland and Houston

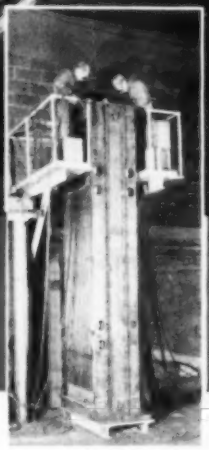


Each heat exchanger is individually hydrostatically tested to insure against leakage during operation. While under test, the by-pass baffles are welded on the unit.

One of the many wind tunnel heat exchanger sections, ready for shipment and installation in the Langley Aeronautical Laboratory supersonic wind tunnel, Langley Field, Virginia



New **Supersonic** Wind Tunnel Coolers are A. O. Smith **Engineering Achievement**



Assembling tubes into the tube headers for one of the heat exchanger sections

All wind tunnel coolers for the new supersonic wind tunnel under construction at Langley Aeronautical Laboratory of NACA, Langley Field, Virginia, were supplied by us.

A. O. Smith engineers conceived an original design in these heat exchangers, incorporating many advantages. The most important ones are:

1. High efficiency through balanced distribution of surface and flow areas.
2. Removable tube bundles.
3. Safety from air contamination by water, through elimination of bolted joints inside the tunnel and placing all water lines and connections outside air chamber.

These and many similar features make this one of the most advanced engineering feats in cooling provision for wind tunnels.

Besides manufacturing varying sizes and arrangements of heat exchangers, we also designed cooler housings, accessory equipment, and air by-pass system, calculated ducts and provided installation.

This is an excellent *example* of the completeness and flexibility of A. O. Smith engineering which is available to you to help solve YOUR heat exchanger problems . . . available through our nearest office, listed below.

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What's Happening . . .

Expansion

. . . **Capital expenditures for refining facilities** will be upped more than 30% in 1953 by 22 large integrated oil companies, according to a survey conducted last month by *Oilgram News*. Data furnished by the companies, who represent 4,000,050 b/d refining capacity, or 55.3% of U.S. total capacity, indicate their capital expenditures for manufacturing next year will be $403,662,044, as against $309,122,463 in 1952. Among same companies, capital expenditures in 1953 are expected to decline 0.04% for production, to drop 10.8% for transportation, and to rise 13.8% for marketing.

. . . **General Petroleum Corp.** will build a 35,000 b/d refinery at Ferndale, Wash., the first modern full-scale plant in Pacific Northwest. Construction is expected to start as soon as necessary permits are obtained, and will be handled, together with engineering and design, by Bechtel Corp. Cost is estimated at $35,000,000, and completion is scheduled for late '54. Units will include primary distillation, Thermofor catalytic cracking, thermal reforming, thermal cracking, and catalytic polymerization. Canadian crude will be supplied through a 40-mile extension from the 24-in. pipe line now being built from Edmonton to Vancouver. The plant site at Ferndale covers 850 acres, and is located on Puget Sound, 12 miles south of Canadian border and 12 miles northwest of Bellingham, Wash.

. . . **Union Oil Co. of Calif.** has taken an option on a 1000-acre site near Seattle, but disclaims any definite plans for a refinery there. "Some day we might want a refinery in that area," company representative said. "We held an option before the announcement that General Petroleum would build. Can't tell whether that will speed up our planning or not." Union's acreage is in vicinity of 2000-acre site Standard of California purchased 20 miles north of Seattle (see What's Happening, Aug. '52, p. 1055).

. . . **Husky Oil Co.** has announced a $1 million expansion program for its Cody, Wyo. refinery, presently rated at 5,000 b/d. Included in program, due for completion in June '53, are a 1,000 b/d Atlantic catalytic reforming unit, a vacuum distillation unit, and auxiliary facilities and tankage. Grebe and Doremus Co. has contract for reformer, Koch Engineering Co. for vacuum unit.

. . . **Esso Standard Oil Co.** is studying feasibility of building a refinery in Puerto Rico. Last month Porto Rican Oil Refinery Co. announced plans for a $20-million refinery at Ponce, to be financed by Puerto Rican and American interests. Still a third plant is believed in the planning stage.

. . . **Proven Oil & Refining Co.** has awarded general contract for construction of its new $18 million 15,000 b/d refinery at Florence, Ariz., to Ebasco Services, of New York. Construction is expected to start about Jan. 1. (See What's Happening, Aug. '52, p. 1055.)

. . . **General Petroleum Corp.** will spend about $10 million on new 19,000 b/d Thermofor catalytic reforming unit at its Torrance, Calif. refinery. Contract has been let to Bechtel Corp. Construction will start around May 1, '53, with project due for completion in July '54.

. . . **New $6 million natural gasoline plant** just completed at Navy's Elk Hills (Calif.) reserve oil fields has been put in "mothballs" and will be held for emergency use only. Plant capacity is 50 MMcf, of gas daily, with provisions for doubling that figure. Preservative oils have been applied to all plant parts subject to corrosion. Cooling sections in cooling tower were sprayed with preserving oils and baffles placed over top of coils to prevent water from dropping on them. Some equipment, such as instruments, electric motors and switch gear, was removed and stored.

Petrochemicals

. . . **Formation of Goodrich-Gulf Chemicals, Inc.,** was formally announced late last month by its parents—Gulf Oil Corp. and B. F. Goodrich Co., thus confirming rumors which had been floating around for months. New company has been organized "for the purpose of exploring projects in the petrochemical field in which the parent companies have strong complementary interests," and will have its headquarters in Pittsburgh. A plant site is being obtained at Orange, Texas, but no further plans have been announced.

. . . **Dominion Tar & Chemical Co.** revealed last month that its new petrochemical plant under construction at Montreal, Quebec, is costing in excess of $10,000,000, will have an annual capacity of about 30,000,000 lbs. of products, and is expected to be in operation in the spring of '53. Plant will produce primarily ethylene glycol and ethylene oxide, with byproducts including diethylene glycol and other poly-glycols, ethylene dichloride, and dichlorethyl ether. Information was contained in brief company presented to Canadian Tariff Board in support of request for tariffs on products it will make.

. . . **Expansion goals for two more petrochemicals** have been set by Defense Production Administration—ethyl chloride and ethylene dibromide. Both goals were established to support the previously announced goal of 570,000,000 lbs. of TEL capacity to be reached by Jan. 1, '54.

Ethyl chloride goal has been set at 630,000,000 lbs., to be reached by Jan. 1, '55. This capacity is an increase of 200,000,000 lbs. over Jan. 1, '51 capacity. Cost of additional facilities to achieve this goal is estimated at $85,000,00.

Ethylene dibromide goal calls for capacity to produce 210,000,000 lbs. by Jan. 1, '55, an increase of 90,000,000 lbs. over Jan. 1, '51 capacity. Cost of these facilities is estimated at $10,500,000.

A roundup of DPA expansion goals and approved

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

projects for these and 20 other petrochemicals is included in this issue—pg. 1793.

. . . **Allied Chemical & Dye Corp.'s** Nitrogen Division is going ahead with plans for its new petrochemical plant at Orange, Texas (see What's Happening, March '52, p. 271), slated to use ethylene from Gulf Oil Corp.'s Pt. Arthur refinery for making ethylene oxide and ethylene glycols. Latest development is acquisition of a 650-acre site on the Sabine River. Construction was scheduled to start late last month, with completion expected in early '54.

. . . **Cold rubber for making tires** is getting a bigger play. Manufacturers of rubber products have told Reconstruction Finance Corp. they will call on RFC's synthetic rubber plants for 173,682 tons of cold GR-S and 141,835 tons of hot GR-S during six-month period ending Mar. 31, '53. Previous consumption of cold and hot rubber has been about evenly divided in recent months.

Industrial Mobilization

. . . **Sulfur supplies are now adequate**, and National Production Authority has removed all limitations on its use and eliminated inventory controls. NPA's Sulfur Order, M-69, which restricted sulfur use to 90% of 1950 usage except for certain defense and essential civilian requirements, was revoked Nov. 5. Two days later NPA Regulation 1 was amended to delete sulfur from list of materials under inventory limitations. Excess of supply of sulfur during 1952 over estimated U. S. consumption is expected to be 134,000 long tons.

. . . **Delays in petroleum expansion projects** are foreseen by Deputy Petroleum Administrator for Defense Eugene Davis because of acute steel plate shortage. Fabricators of such items as heat exchangers and tanks are having difficulty getting their orders for plate filled, Davis said. He expects impact to fall in last half of '53.

. . . **Tetraethyl lead expansion goal** calling for annual capacity of 570,000,000 lbs. by Jan. 1 '54 has been announced by Defense Production Administration—but merely for the record. Sufficient rapid tax write-off applications have already been approved to meet this goal.

. . . **Loan for rehabilitating alkylation unit** at Houston refinery of Eastern States Petroleum Co. has been approved by Reconstruction Finance Corp.—$1,250,000 at 5% interest and maturing in 6½ years. Eastern States signed contract with Armed Services Petroleum Purchasing Agency last Spring for putting 2100 b/d unit back into operation (see What's Happening, Apr. '52, p. 407).

Markets, Prices

. . . **Rising rates for water transportation** made for firmer prices at terminals along the East Coast and in the upper Midwest during November. Prices also continued firm and unchanged at the Gulf, except for lubricating oils, and refiners showed little inclination to offer heating oils despite rising inventories.

Smog and low water on the Mississippi south of St. Louis impeded the upward movement of heating oils, and light-loading of barges slowed down refinery sales at the Gulf. Kerosine and No. 2 fuel, as a result, were closely held in the Chicago District.

On the East Coast, tanker rates from the Gulf ranging up to USMC plus 50% tended to reduce offerings of No. 2 fuel, and the "discounts" at New York harbor that at times were as much as 0.4c per gal. off posted barge prices disappeared.

. . . **Residual fuel surplus was on the wane**, according to signs evident in all seaboard districts. Prices were firm at $1.50 per bbl., cargoes, at the Gulf, and "discounts" appeared on the way out at New York. In the Mid-Continent, on the other hand, offerings to tank car sellers continued available as low as $0.70 per bbl. Refiners in Oklahoma, Kansas, Arkansas and inland Texas generally said that warm weather had hampered their efforts to move light and heavy fuel oils.

. . . **Specialty products sales were slow** and many prices subject to shading, with the exception of natural gasoline. LP-gases could be purchased freely in Oklahoma and Texas. Wax prices were "soft" both at New York harbor and in the Southwest. Solvent refined lubricating oils, FOB ship at the Gulf, were off 1c to 29c for 150-160 vis. bright stock, and in amounts ranging from 2.5 to 3c for neutral oils. South Texas pale and red oils also were quoted lower for low viscosities; according to one refiner, prices were weak enough to consider using the material as charging stock.

. . . **Ample crude supplies were available to refiners**, except for California and Western Penna. A feature in California was the importation of supplemental supplies of crude from Sumatra, Indonesia, and Saudi Arabia.

Miscellany

. . . **Autofining process for catalytic desulfurization** is now available in this country through M. W. Kellogg Co., as result of licensing arrangement concluded by Kellogg with Anglo-Iranian Oil Co., which developed process. (Details of process were published in April issue, p. 467.)

. . . **Standard 120-lb. grease drum specifications** have been adopted by API-NLGI Joint Container Committee, following approval several months ago by API Lube Committee. Standardized specs call for: 20 lug cover, 14¾-in. diameter by 25⅜-in. high container, full open head. Container has volume of 16.2 gal.

. . . **Octanes in Canada are up.** Results of survey made last summer by Mines Branch of Canada's Department of Mines and Technical Surveys and just made public, show that:

Average octane rating for premium grade gasoline during summer of '52 was 88.7 Research, as compared with 87.2 Research in summer of '50.

Average for regular grade gasoline for summer of '52 was 84.0 Research, as compared with 82.4 rating in summer of '50.

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you get it in the

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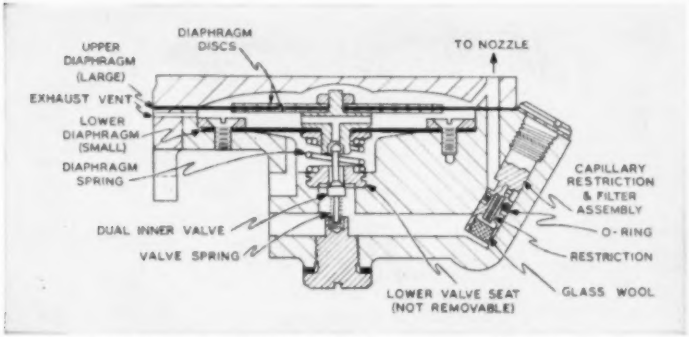
Pneumatic Controller



HOW IT WORKS: When flapper is moved against nozzle by measuring system, pressure increases on top of large diaphragm. Floating exhaust seat moves downward pushing lower or inlet valve open increasing pressure in output circuit and under small diaphragm until balance of forces closes the valve. Conversely when nozzle is vented, the diaphragm system moves upward to open exhaust valve, reducing pressure in output circuit until equilibrium is again established.

The F&P FLOWRATOR meter was the first flow rate meter generally available to exhibit instantaneous response to flow rate change, leading to control problems that have been presented by current mechanical differential type flow transmitters.

Rapid response of the control valve is essential for stable control in a system which changes rapidly. Since the control valve action depends upon the capacity of the relay supplying it with air, the requirement for a high capacity stable relay required solution. Consequently, the P-4 relay has been designed to be extremely fast without impairing its basic sensitivity due to hydrostatic unbalance. The P-4 relay utilizes tandem slack diaphragms which provide the multiple requirements of high capacity, low air consumption "on control", and freedom from all dead zone. Write now for Catalog C-50.

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Versatility—one relay fits transmitter, and all case and point-of-measurement controllers.

Integral unit—permits fool-proof construction without tubing connections.

High capacity—essential for best in flow control.
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Capacity fully usable—transfer switch ports and connectors match relay high capacity.

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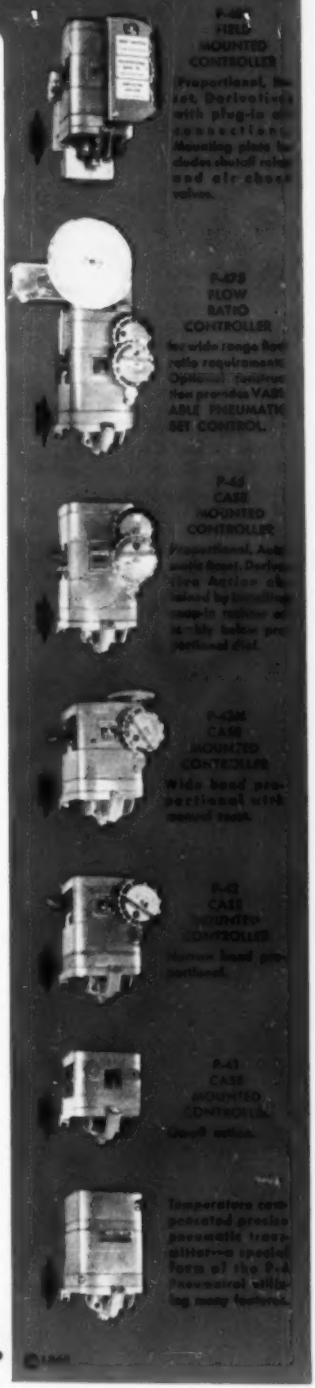
Materials—aluminum die cast body with brass insert, neoprene diaphragms. Trim, springs and screws of stainless steel.



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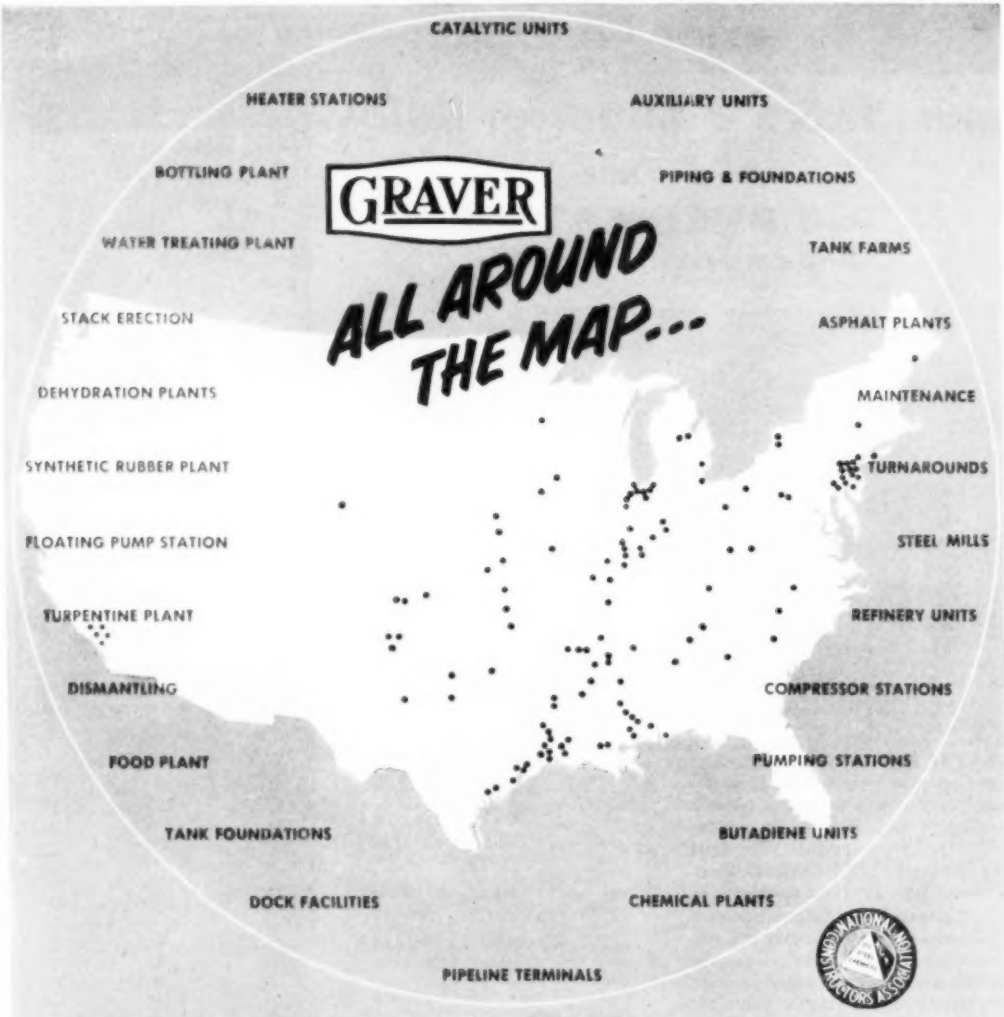

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Northwest Expansion Closer with General Petroleum's Refinery Plans

CRUDE oil from western Canada, already making its way from Alberta into the Great Lakes region of Ontario via the 1500-mile Interprovincial Pipe Line, will soon begin to show itself on the American scene, flowing into the northwestern United States markets, as predicted by this magazine four months ago.[1]

General Petroleum Corp. announced plans last month to build a 35,000 b/d refinery at Ferndale, Wash., supplied by Alberta crude through an extension of the Trans Mountain Pipe Line from Edmonton, Alta., to Vancouver, B. C.[2] Located on Puget Sound, 12 miles south of the Canadian border and 100 miles north of Seattle, the new plant will be the first modern full-scale refinery in the Pacific Northwest. Cost is estimated at $35,000,000, that of the pipe line extension at $2,750,000.

Impact on the Northwest is seen as two-fold by oil officials.[1] First, the tight supply situation will be relieved, if it has not already eased, by 1954. The supply situation has been taut on the West Coast since last year and has been especially acute in the Pacific Northwest. Second, rough competition for the market will be intensified.

Refinery capacity will be keyed to the growth in General Petroleum's normal share of the market. The Pacific Northwest market of 260,000 b/d is expected to be over 321,000 b/d in 1955, according to Stanford Research Institute. That's an increase of more than 61,000 b/d. Initial capacity of the pipe line, which is expected to be in operation in October, 1953, will be 120,000 b/d. Highest expected refinery capacity at Vancouver has been estimated at about 39,500 b/d, sufficient to meet the area's needs.

Short arithmetic indicates that eventually crude could stockpile at the U.S. border at around 80,000 b/d with the pipe line's initial rate—and more if it is raised to 200,000 b/d capacity as expected by some. The new Ferndale refinery would reduce that initial surplus to 45,000 b/d.

Various conclusions can be drawn. One actual fact is now known in addition to General Petroleum's plans—Standard Oil Co. of California announced recently the purchase of about 2000 acres of land on Puget Sound about 20 miles north of Seattle.

—W.C.U.

(1) "Refiners Look to Pacific Northwest," by Frank Rooke, Petroleum Processing, August 1952, pp. 1123-6.
(2) "General Petroleum Plans Northwest Refinery," National Petroleum News, November 12, 1952, pp. 29-30.

Large-Scale Lignite-Fueled Power Plant Soon Goes into Operation

THE nation's newest aluminum smelting plant, Aluminum Co. of America's Rockdale, Texas, Works, was put "on stream" late last month when 25% of its productive capacity went into operation. The second 25% was scheduled for operation this month, and the remainder for the fall of 1953.

This fact is of considerable importance to aluminum users because the new facilities will ultimately have an annual capacity of some 170,000,000 lbs.

More significant, however—and particularly to the petroleum industry—is the fact that the plant's electrolytic process will use electric power supplied by a new lignite-fueled power plant. The lignite is to be mined in Milam county in the vicinity of Rockdale, and about 125 miles northwest of Houston.

It is said to be the first plant of its type in the country to use lignite for power generation. Before burning, the lignite is dried by a new method developed by the Bureau of Mines at Denver, Col., under the sponsorship of Texas Power & Light Co.

The Denver research program demonstrated the feasibility of using lignite for large scale power generation purposes, Alcoa officials explained. Availability of the fuel in Milam county was instrumental in the decision to locate the aluminum plant there. Furthermore, Texas lignite is a low-cost fuel. It's obtained by strip-mining, and in 1949 had an average value of only $1.02 per ton, when the national average for strip-mined bituminous coal and lignite was $4.11/ton, according to "Minerals Yearbook." These factors help overbalance the lignite's shortcomings as a fuel of relatively low energy content.

Finally, the coal industry is on an upturn in its progress toward reduced mining costs with increased use of mechanized equipment; whereas, the petroleum producer has been facing rising expenses in getting crude out of the ground.

Petroleum economists taking the long view at the overall energy picture will be watching the Rockdale lignite installation with interest. —W.C.U.

Higher Prices Forecast for LPG As Petrochemical Raw Material

THE growing use of liquefied petroleum gas (propane and butane in the conventional sense) in various fields is almost certain to increase, by up to a third, the price of this versatile chemical material in the next few years.[1] About a fourth of the 119 million bbls. of available liquid C_3-C_4 hydrocarbons, or 26 to 28 million bbls., went to chemical manufacturing in 1951. Chemicals consumed negligible quantities just ten years ago.

Increasing the volume of available LPG by 64 million bbls. annually (about one-fourth of the available volume potentially recoverable) could be justified only with a price increase of 2.5c over present levels.

Due to government-encouraged emergency expansion, the use of propane and butane in regular chemical channels is expected to increase about 25% in the next three years. If other uses in which these hydrocarbons show promise actually develop, such as chlorinated and nitrated hydrocarbons in the fields of detergents, insecticides and solvents, or the large potential outlets via the Wulff process for acetylene and the OXO conversion of propylene and carbon monoxide into butyraldehyde, look for an even stiffer increase in chemical usage.

There will be a price increase whether chemical demand goes up or not, these authorities anticipate. The growing trend of selling fuel gas on a therm basis (100,000 Btu) is cited as an important factor

which is expected to prevail soon at sources of supply in the Southwest.

Seventy per cent of recovered C_3-C_4 liquids now are used as fuels. Unrecovered hydrocarbons are sold as natural gas at 6c to 12c per Mcf. (equivalent to 0.5c a gal. for propane and butane).

On a therm basis equivalent to natural gas at 12c per Mcf., propane and butane all have values exceeding 1c per gal. It is believed that gas soon will reach a value of 20c per Mcf. at the field.

Propane costs 4c now and butane 4.5c a gal. f.o.b. plant in the Southwest, in line with present gas prices ranging from 6c to 12c per Mcf. It is believed that chemical plants should plan in future to pay 4c to 7c a gal. for propane, not relying too strongly on any very large supplies at 4c.

The picture for butanes is more complicated, as these hydrocarbons may be used more extensively than at present in conventional motor fuel at 10c per gal. and in synthesis of motor fuels by polymerization and alkylation.

These authorities do not believe that prospective increases in the price of natural gas, even on a 100% load factor basis, and LPGas hydrocarbons, will be too much for the chemical industry to pay for raw materials. —D.P.T.

(1) "Ethyne: A Versatile Chemical Raw Material," by R. H. Carver, Manager, Gas Division, and R. E. Meyer, Manager, Research Dept., Marco Petroleum Corp. Talks presented before Organic Work Meeting, American Institute of Chemical Engineers, Tulsa, Oct. 13, 1952.

Deposits Are Hurdle in Path To Higher Compression Engines

CURRENT studies in combustion chamber deposits emphasize their effect in increasing the octane requirement of engines, and thus place a higher evaluation on finding the means to eliminate deposits.

While the increase in antiknock requirement of engines which results from the accumulation of combustion chamber deposits is not a new problem, states one group of investigators, "it has become of greater importance as the antiknock quality of fuels and the antiknock requirements of engines have reached higher levels."(1)

Previous reports are referred to as indicating that an average value for the increase due to deposits in passenger cars is about 10 octane units in the 80-90 octane number range. "From the standpoint of the automotive industry", it is stated, "the efficiency of engines could be improved by the benefits from compression ratios approximately one unit higher if the effects of combustion chamber deposits on requirement could be eliminated."

In the opinion of the authors, deposit effects in increasing antiknock requirements can be ascribed to (1) increase in compression ratio caused by the physical volume of the deposits, (2) heating of the intake charge by the deposits. Measurement, by means of a sonic device, of combustion chamber clearance volume before and after deposit removal have indicated that deposits in multicylinder engines increase the compression ratio as much as 0.3 unit. "This can be considered as equivalent to an increase in the requirement of about two units in the 80-90 octane number range."

Recognizing the variability in deposit effects in road tests due to several factors, the Ethyl Corp. investigators developed a laboratory engine test procedure, the conditions of which simulated light-duty passenger car service. Their studies were of a wide range, including fuel oil and TEL as well as engine and operating conditions and combustion chamber design. The summary of their tests is prefaced with the statement that the problem warrants extensive research. Points brought out are:

(1) Fuel and oil effects on deposit formation are closely inter-related;

(2) With commercial gasolines, as well as with special hydrocarbon fuels, there is a trend toward smaller octane requirement increase as fuel end-point is reduced;

(3) TEL added to pure hydrocarbon fuels of different chemical types may have different effects.

(4) Removal of heavy ends from lubricating oils tends to lessen requirement increase.

These studies and others along the same line emphasize that finding the means to keep the combustion chamber free from deposits will eliminate one hurdle in the path of higher compression engines. —V.B.G.

(1) "Combustion-Chamber Deposits and Knock," by F. J. Gibson, C. A. Hill and W. A. Hirschler, Ethyl Corp.; presented at SAE National Fuels and Lubricants Meeting, Tulsa, Nov. 6-7, 1952.

Atomic Work Spawns Another New Sensitive Analytical Instrument

ATOM-SMASHING research seems to be the latest source of a new analytical tool which may find use in the petroleum or petrochemical industries. Nicknamed the "Proton Bombarder," the new analyzer was evolved from apparatus and techniques developed in atom-smashing studies at and by Stanford Research Institute.(1)

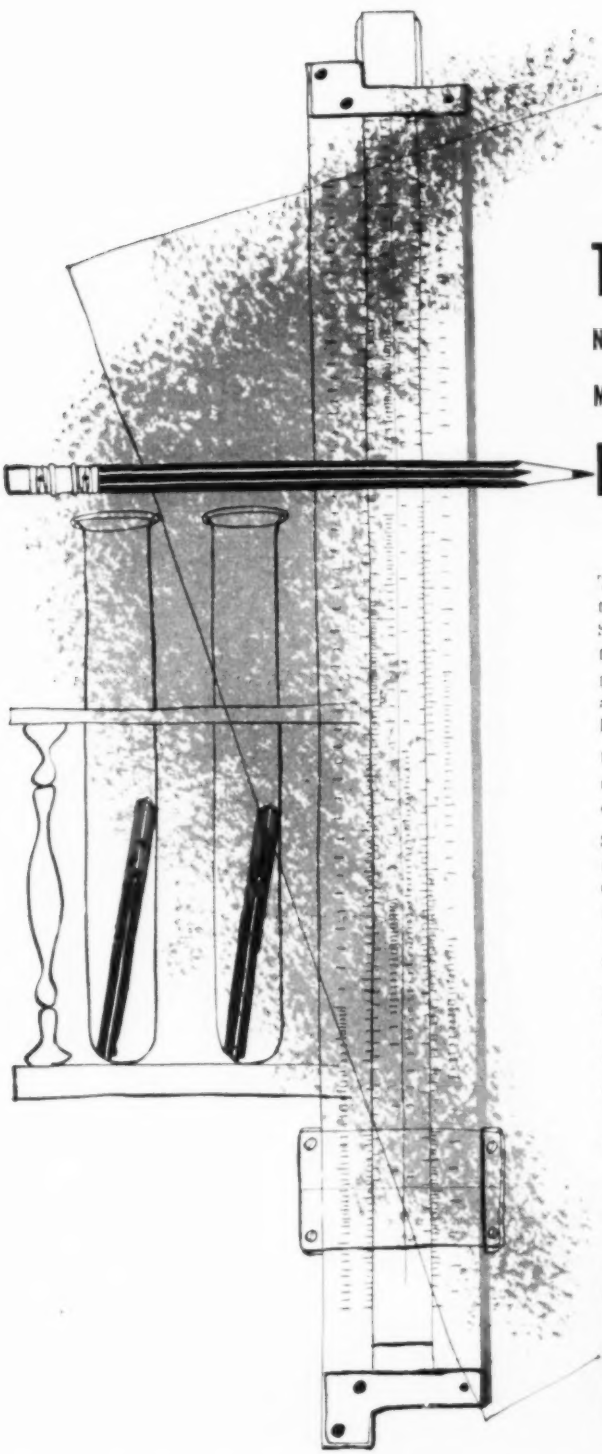
Possible industrial applications for the new surface analyzer, as seen by the Institute, include studies of lubricants, coatings, and finishes, and analysis of surface contaminations or of minute unknown samples. Its immediate use will be in the study of properties and surface behaviors of various metals. One application is to test metallic structures of alloys for the Ordnance Department of the Army.

High sensitivity is claimed for the device. It can detect an element in an amount as small as 0.000000000001 gram (that's a millionth of a millionth, or a trillionth), according to S.R.I.

In essence, it is an ion-scattering apparatus. In a conventional atom-smasher, protons hit the target with such great velocity that the atoms are altered. In the new analyzer, the protons travel at lesser speeds and bounce off the atoms without changing them. They emerge from a vacuum tube at about 6200 miles/second. As they penetrate the sample they reach the atomic nuclei of the contained elements and bounce off again. The heavier the atom, the greater the rebound velocity of the protons. Although all rebounding protons lose some velocity, the losses vary according to the atom hit. It is this loss which identifies the atoms.

Cost of the Institute's first analyzer—about $200,000—certainly takes it out of the plant control type of instrument. However, its high sensitivity should make it interesting to those seeking new and improved analytical tools for research. —W.C.U.

(1) Research for Industry, November, 1952, monthly news bulletin of Stanford Research Institute.



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Write for Technical Bulletin No. 0-86. This gives test results, typical inspection values and other information on Santolube 70. MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 800 North Twelfth Blvd., St. Louis 1, Missouri.

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At present, the unit is being used for catalytic desulfurization of straight-run and thermal cracked gasolines. As a result, PEMEX has been able to improve the quality of their regular grade gasoline and increase the quantity of the premium grade. In addition, during the first month of Cycloversion operation, the TEL requirements for this refinery's gasoline production were 74,000 pounds less than for the preceding month.

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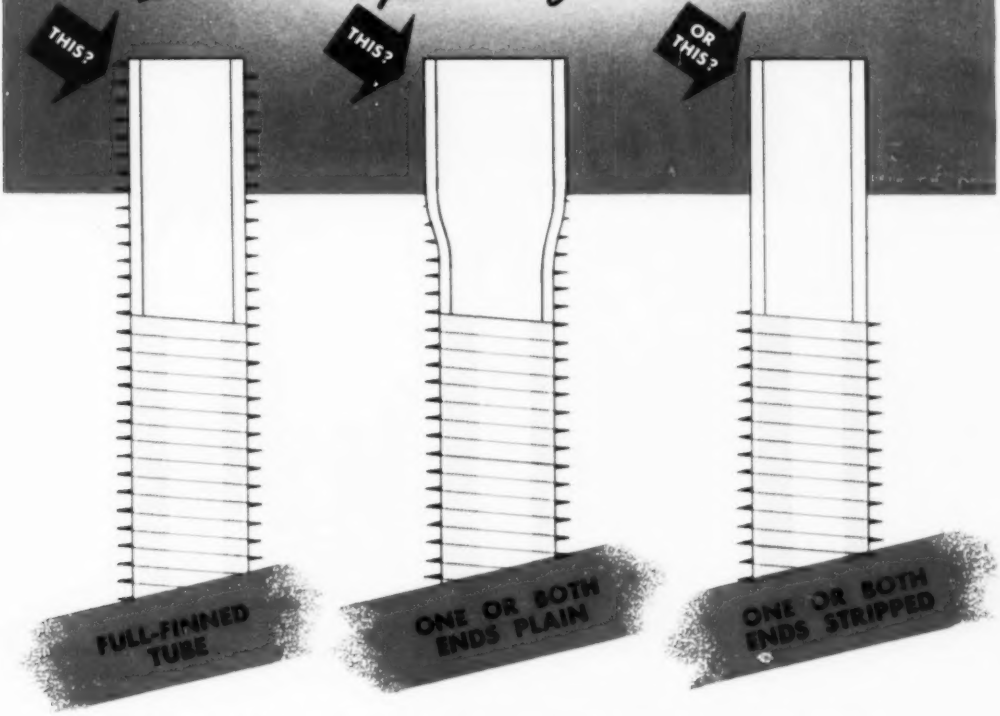

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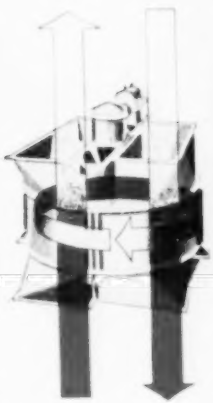

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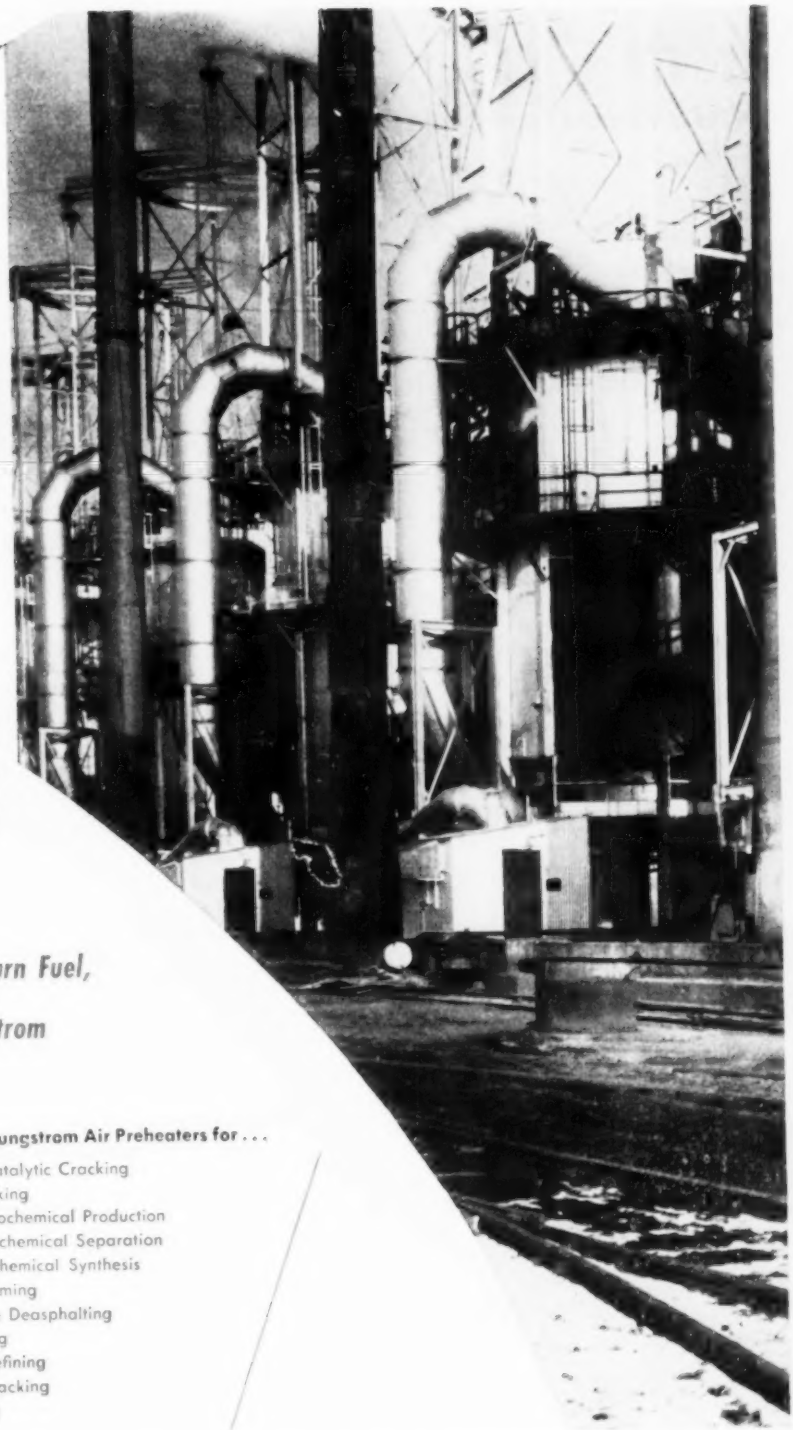

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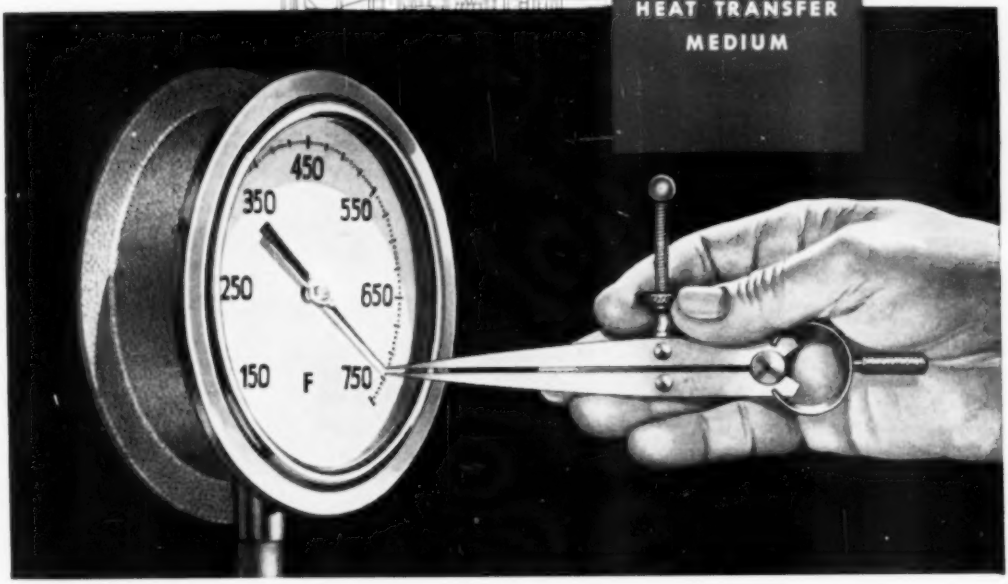

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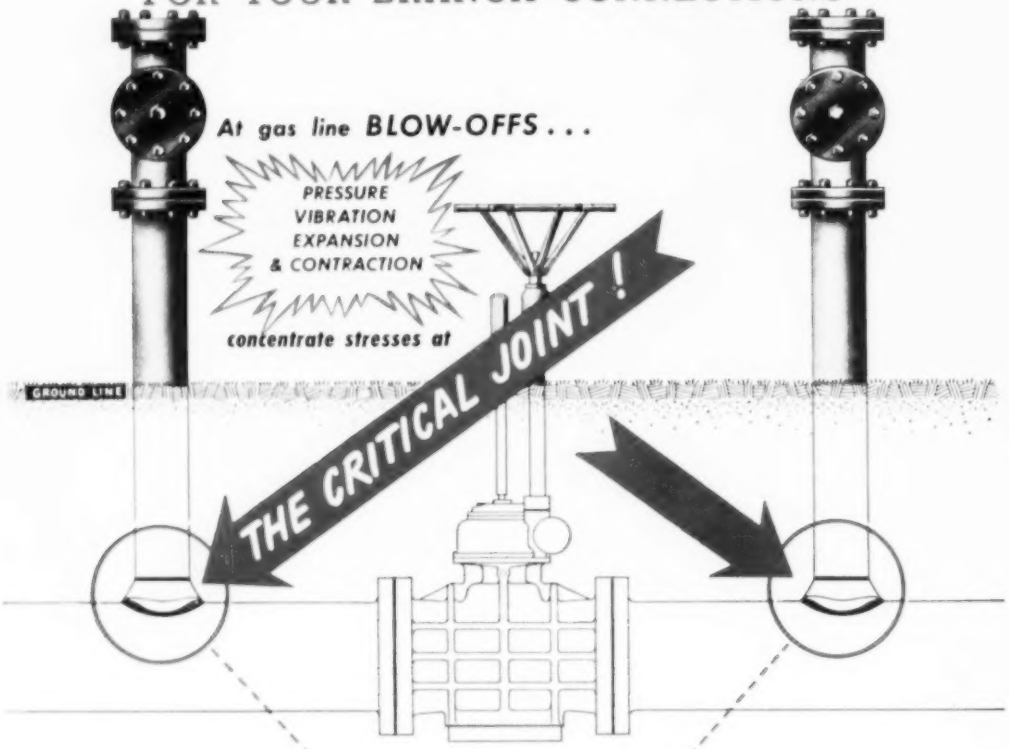

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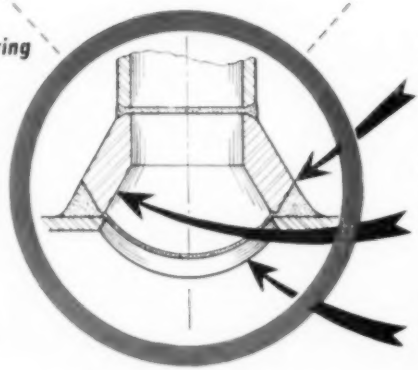
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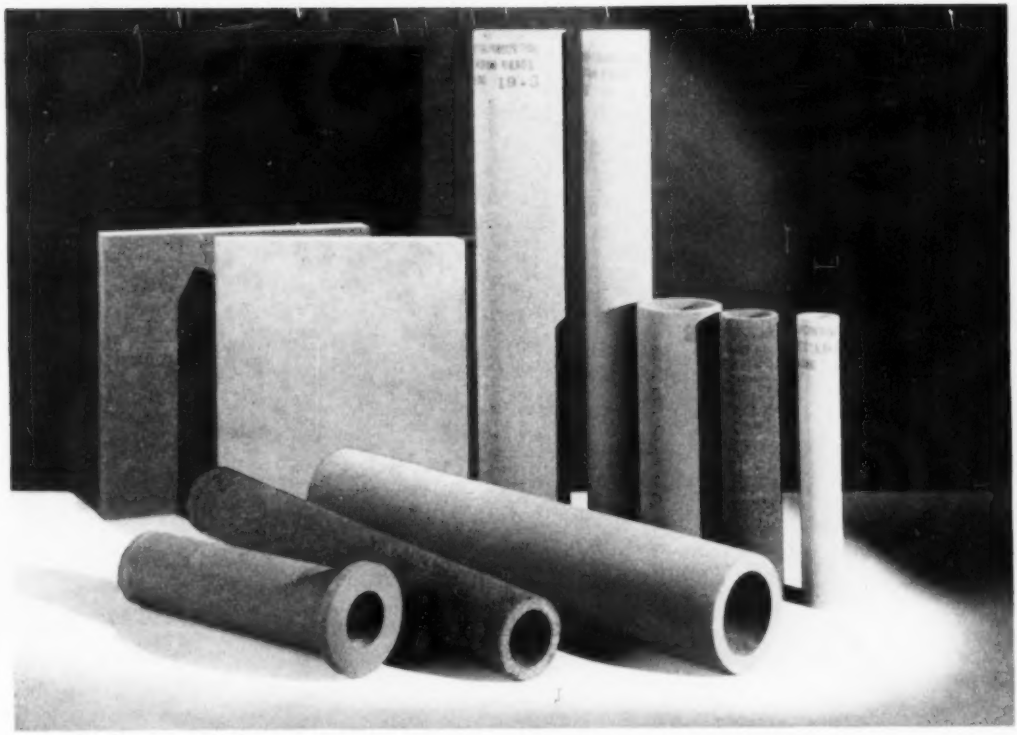

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Increase the efficiency of your filtration system with Norton porous seamless tubes. Made of long lasting ALUNDUM grain, their seamless construction assures more uniform filtration and faster, more thorough cleaning by backwashing.

Used in systems filtering water, solvents, cutting oils, wine, food oils, and other liquids . . . in reclaiming cleaning fluids, industrial waste . . . in swimming pool filtration, and boiler feed water treatment.

Norton porous mediums, in both tube and plate forms, bring you chemical stability unaffected by most corrosive acids, strength that assures maximum resistance to breakage and chipping . . . controlled structure (an exclusive Norton process) that permits *positive* control over grain spacing and predetermined pore size and open pore ratio to meet your requirements.

Send for Bulletin No. 140

Plan now to get complete data on these Norton refractory products by obtaining Norton Bulletin No. 140: "Norton Porous Mediums." Ask your Norton representative for a copy or write us direct. NORTON COMPANY, 263 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON

POROUS MEDIUMS

Making better products to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

Cut yourself a Slice of Fractionating Profits

10 years of "know how" and 300 installations have proved the Kaskade tray is the answer to higher capacities and efficiencies. We'll be glad to share your fractionating problems. Write us today.

KOCH ENGINEERING COMPANY, INC.

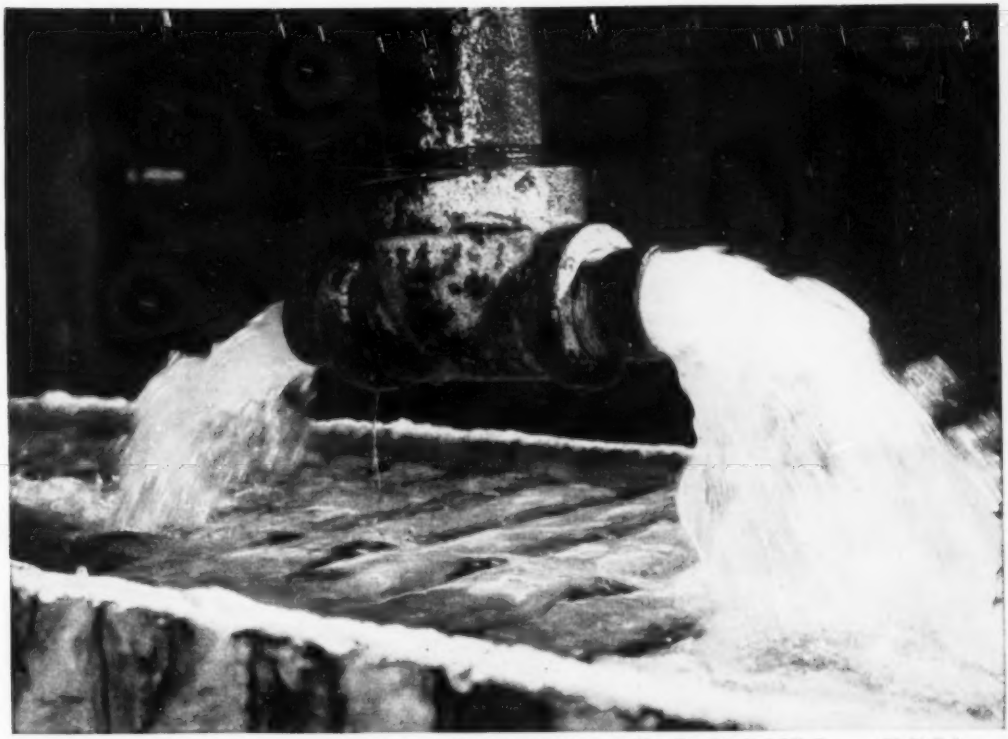
DESIGNERS • MANUFACTURERS • BUILDERS

Export and Export
30 Rockefeller Plaza
New York City

Pittsburgh, Pa., Repr.
D. D. Foster Co.
512 Peoples Gas Bldg.

Tulsa, Okla., Repr.
Myers-Dogwell Co.
Wright Bldg.

Branch Associates
Messrs. A. F. Craig & Co., Ltd.
Paisley, Scotland



LIQUID WAX pours into a mold at Esso Standard Oil's Bayonne (N. J.) Refinery.

Solvent extraction at 200,000,000 lbs a year

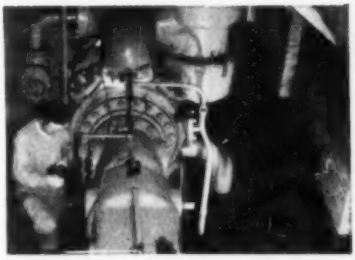
The Esso Standard Oil Company's Bayonne (N. J.) Refinery dewaxes oils by solvent extraction of chilled charge stocks. This process enables Esso to produce up to 200,000,000 lbs of oil-free wax and up to 1,000,000 gallons of wax-free lubricating oils every year.

Vital *chilling* used in this MEK dewaxing process is provided for by Worthington equipment including 3 ammonia compressors, 6 chilling machines, 6 exchangers, 3 centrifugal pumps, 2 instrument air compressors and 1 high-volume pump handling anhydrous ammonia.

As a user of Worthington refrigeration equipment, Esso is part of a long list of "big-name" Worthington users. Others include: E. I. Du Pont de Nemours & Co., Edgemore, Del., Orange, Tex.; Minnesota Mining and Manufacturing Co., St. Paul, Minn.; Shell Chemical Co., Houston, Tex.; Standard Oil Co. of California, Richmond, Calif.; Sinclair Refining Co., Houston, Tex.; Tidewater Oil Co., Bayonne, N. J.

The advantages that go along with the Worthington name are known the world over. No other manufacturer makes so complete a line. And every Worthington system is Worthington-*made*, not just Worthington-assembled — assuring you of perfectly balanced operation and unit responsibility.

Worthington Corporation, Air Conditioning and Refrigeration Division, Harrison, New Jersey.



PARTIAL VIEW of one of the three Worthington Balanced Opposed Ammonia Compressors (27½/16½ x 15; 900 hp), part of the Worthington equipment used at MEK plant at the Bayonne (N. J.) refinery of Esso Standard Oil Company. A-2-32

WORTHINGTON

Air Conditioning and Refrigeration

Consider *your present and possible uses for*

OXYGEN and NITROGEN

you may be be able to

- Save thousands of dollars per year
- Convert waste products into profits
- Increase production, broaden your business

by making your own--with

Air Products High-Purity or Tonnage
OXYGEN-NITROGEN **GENERATORS**

✓ *Check your interests - - - fill in and mail for our NEW CATALOG* also an outline of what we've done on needs like yours

Steel Making, Processing

OXYGEN USES:

- ☐ Furnace enrichment
- ☐ Scarfing
- ☐ Cutting
- ☐ Welding

NITROGEN USES:

- ☐ Annealing
- ☐ Heat treating
- ☐ Inert atmospheres
- ☐ Furnace brazing

Chemical Manufacturing, Processing

OXYGEN USES:
Production of Synthesis Gas for

- ☐ Ammonia
- ☐ Acetylene
- ☐ Methanol
- ☐ Other Chemicals (specify below)

NITROGEN USES:

- ☐ Ammonia synthesis
- ☐ Atmosphere control
- ☐ Nitrogen for use in drugs
- ☐ Liquid nitrogen scrubbing of synthesis gas

Others _____

Air Products
INCORPORATED
Dept. L, Box 538
Allentown, Pa.

NAME _____ TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ STATE _____

Handling the turnaround problem on petroleum processing units is just one of the many services offered by Procon to the petroleum and petrochemical industries. Procon's work includes not only the construction of major processing facilities but office buildings, electrical installations, sewers, roadways, and utilities.

Procon's **demonstrated** ability to handle any job—large or small—and see it through from ground-breaking to on-stream is proof of the company's flexibility. And concentration of this flexibility in a specific field provides the specialized knowledge and experience that are required in today's operations.

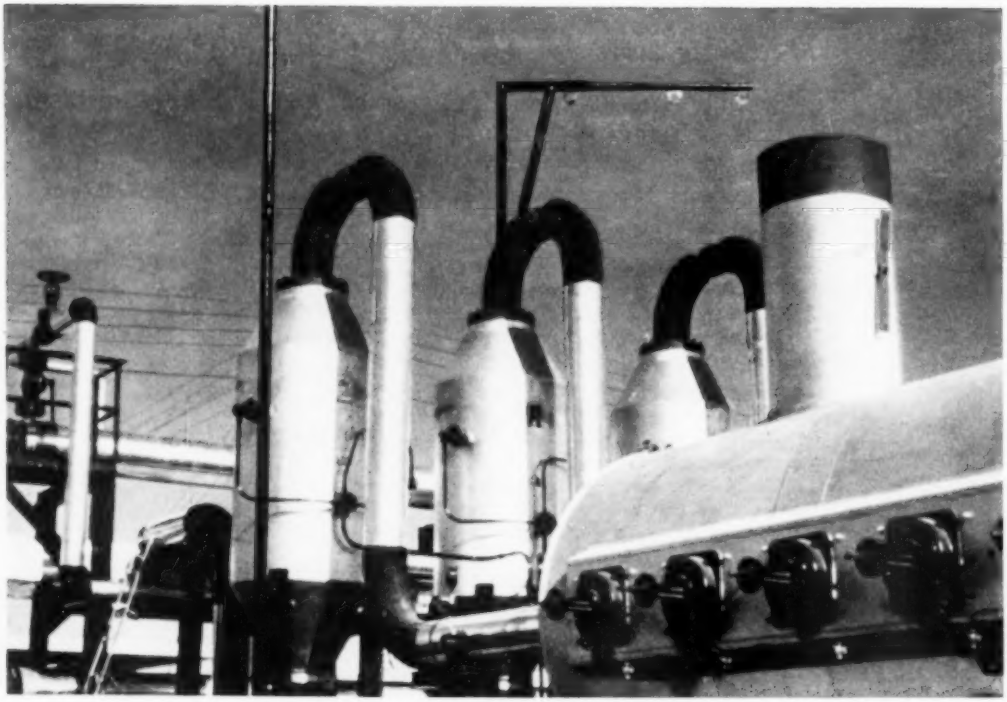
The advantages of this effective combination are reflected in the efficiency and economy with which Procon has handled its projects and in the number of jobs it has been awarded during the past two years.

PROCON *Incorporated*

PROCESS CONSTRUCTION
1111 MT. PROSPECT ROAD, DES PLAINES, ILL., U.S.A.

CATFORMING...

the Atlantic catalytic reforming process



McBride Refining's Catforming unit at La Blanca, Texas

... the refiner's solution to high octane requirements with low operating and investment costs.

For two years, frequent notices in trade journals and the public press have been giving you advance news on the Catforming process by The Atlantic Refining Company. Now, successful commercial operation is under way.

it's the catalyst that counts

Since catalytic reforming was first utilized, numerous processes have been introduced to increase its benefits. None of these completely satisfied our requirements. So we looked for the answer in the catalyst itself.

years of research

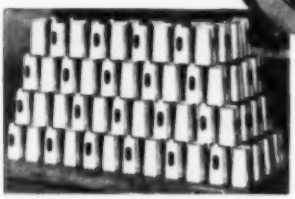
Years of continuous laboratory study were devoted to the problem . . . in a search for a new catalyst with superior qualities. This extensive research paid off in a completely new catalyst which is the heart of Catforming. This catalyst combines improved selectivity, greater stability, excellent resistance to poisoning, and ease of regeneration.

now in commercial operation

Catforming is now in successful commercial operation. It is giving exceptional results. Our engineers are ready to give you the whole story. Call or write The Atlantic Refining Company, Research and Development Dept., P. O. Box 8138, Philadelphia 1, Pa. (Telephone, HOward 5-2345).

ATLANTIC

This Monel tube bundle used in an HF Alkylation Unit Dehydrator Reboiler is an excellent example of the use of Monel to resist corrosive chemical attack even at high operating temperatures.



These plugs for 2 inch plug valves used in hydrofluoric acid alkylation service were machined from Monel rod. No. 130 Monel Arc Electrodes are used for overlaying steel plugs on larger valves.

How Monel muzzles HF ...even at high temperatures

Monel lined hydrofluoric acid regenerator column with 1/16" minimum lining of Monel. The two Monel grids are for holding the Raschig rings.

Anhydrous hydrogen fluoride and hydrofluoric acid are good and valuable servants. *But* they have to be controlled with a firm hand.

Allowed to have their own way, they'll chew right through most materials. Some materials resist the dry or highly concentrated acid but succumb to dilute solutions; other materials act in the reverse.

But it's a different story with Monel®!

Experience in hydrofluoric acid alkylation units has proven that Monel is usefully resistant to attack by aqueous HF in all concentrations at temperatures up to 250° F. with anhydrous acid and steam-HF mixtures, Monel shows good resistance at temperatures as high as 1100° F.

Monel is comparatively insensitive to the effects of velocities which increase the corrosion rate of other materials. Therefore, it is suitable for valves, pumps and pipe lines, for impellers, stators and shafts, and for bubble caps and linings in hydrofluoric acid distillation columns.

It does not acquire a scale when exposed to anhydrous HF which makes it especially useful for moving parts having close clearances, such as plug valves and pump rings.

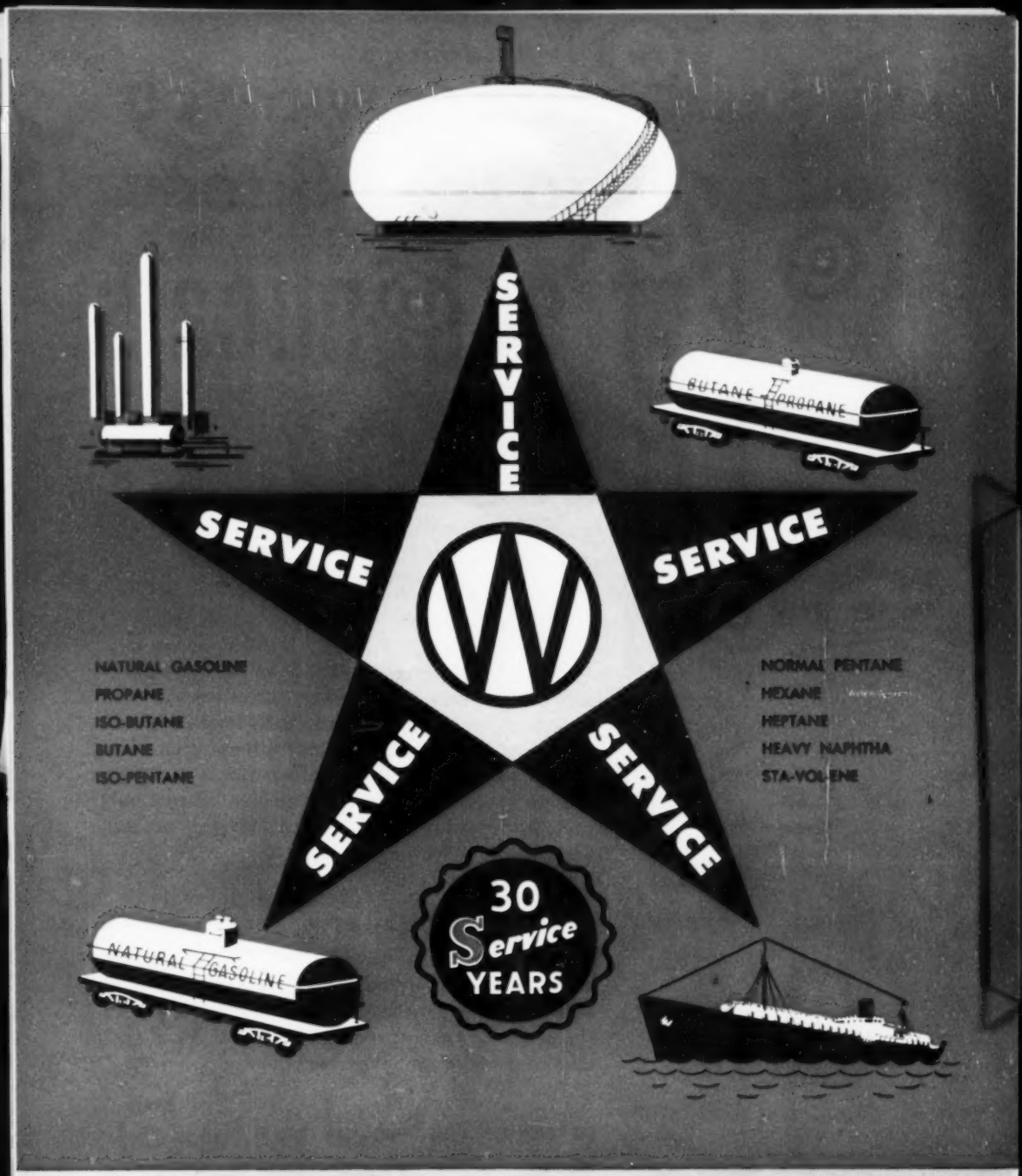
In addition to excellent chemical characteristics Monel provides its well-known physical properties . . . high strength . . . easy fabrication and welding.

Right now, Monel is on extended delivery because so much is needed for defense. Therefore, it's wise to order well in advance and be sure to include NPA rating and complete end-use information.

And if you have a special metal selection problem, Inco's Corrosion Engineering Section will be glad to help. Write them today. Write also for your free copy of "Corrosion by Hydrofluoric Acid," reprinted from The Oil and Gas Journal.

The International Nickel Company, Inc.
67 Wall Street, New York 5, N. Y.

MONEL . . . *for minimum maintenance*



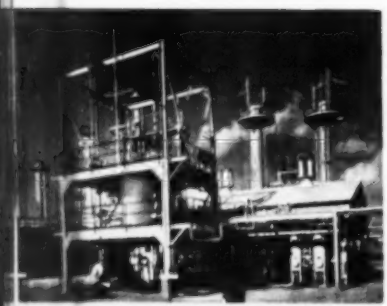
WARREN

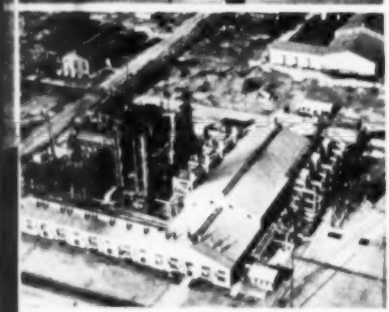
PETROLEUM CORPORATION

TULSA, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS

HERE ARE 5 REASONS WHY YOU SHOULD TALK TO M. W. KELLOGG ABOUT Petrochemicals Processing...





1 NEW PROCESSES AVAILABLE . . .

Using new processing techniques, Kellogg is now in a position to design plants for the production of a wide variety of valuable chemicals from hydrocarbon feeds. As a result of recently completed arrangements these include, for example, urea via Montecatini's vastly improved process. Others are ammonia, phenol and acetone, aromatics, higher aliphatic and cyclic alcohols, and phthalic anhydride.

2 CURRENT PRACTICAL DESIGN EXPERIENCE . . .

Today, with nearly a score of different chemical plants either under construction or in engineering, Kellogg is able to offer broad chemical experience—all based on the practical chemical engineering philosophy of continuous processing in integrated plants.

3 EXTENSIVE LABORATORY FACILITIES . . .

Kellogg pilot plant and organic laboratory facilities are among the most extensive in the industry. The firm is well known among the process industries for its ability to cooperate closely in the development of new proc-

esses—and for its engineering know-how in the translation of pilot plant and semi-commercial plant data into profitable commercial operations.

4 PETROCHEMICAL BACKGROUND . . .

Since World War II when Kellogg engineered butadiene and ammonia plants . . . and later, special units for the production of ethylene, hexylene glycol and ethyl chloride as well as highly efficient fractionation systems for the concentration of butylene . . . the company has continued its research and development work in this expanding field.

5 BASIC ENGINEERING DATA . . .

Behind the relatively new developments in chemical processing, Kellogg has a vast reservoir of technical data built up over years of designing, engineering and erecting petroleum refineries all over the world. Much of this experience is directly applicable to chemical process design.

• • •

If you have a refinery by-product that you wish to upgrade in value to petrochemical intermediate or final product, consider Kellogg's *practical* experience. Write—

Chemical Process Division

THE

M. W. KELLOGG COMPANY

KELLOGG PULLMAN

for fifty one years an integral part of processing history!

NEW YORK • JERSEY CITY • LOS ANGELES • TULSA • HOUSTON • TORONTO • LONDON • PARIS

These current projects demonstrate Kellogg's versatility in the chemical field . . .

AMMONIA
ISO-OCTYL-ALCOHOL
PHENOL
AROMATICS

In the United States

For Shell — An anhydrous ammonia plant for the West Coast.

For Standard Oil Co. (Indiana) — An iso-octyl-alcohol plant now under construction in the midwest.

For Pan-Am Southern — The first Fluid Hydroformer. Although scheduled to upgrade naphthas to high grade motor gasoline, the unit can alternatively produce aromatics such as benzene, toluene and xylene.

For Cities Service — Two more Fluid Hydroformers, one for the Midwest and the other for the Gulf Coast.

SEVEN PLANT COMPLEX

In Italy for Montecatini — Seven important units for the production of ethylene, propylene, and butylene as well as final products such as isopropanol, secondary butanol and phthalic anhydride.

PHENOL FROM CUMENE

In Canada for B-A Shawinigan — The World's first phenol-from-cumene plant. Scheduled for completion early next year, it promises to provide high quality phenol at low cost.

NAPHTHA PYROLYSIS

In England for ICI — Just completed, a naphtha pyrolysis plant producing better than 99.8% pure ethylene as well as useful by-products such as propylene and butylene. Also for ICI, a phthalic anhydride unit, now in engineering.

GASOLINE FROM COAL SYNTHESIS

In South Africa for SASOL — A large gasoline-from-coal synthesis plant employing Kellogg's Synthol process. Special separation equipment to recover valuable alcohols and other oxygenated chemicals is part of the program.

better measurement and control of

LIQUID LEVEL

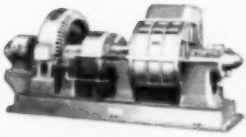
In the measurement or control of liquid level — whether your problem involves turbulent, viscous or corrosive liquids, open tanks or closed pressure vessels — Foxboro offers complete diversity of premium-quality instruments to meet the requirements . . . and unmatched application experience to guide specification or design of the most efficient system for your operation.

INDICATORS • RECORDERS • CONTROLLERS
diaphragm, bubble tube, float, and differential pressure measuring systems for open or closed vessels
PNEUMATIC OR ELECTRONIC TRANSMISSION
• CONTROLLED VALVES

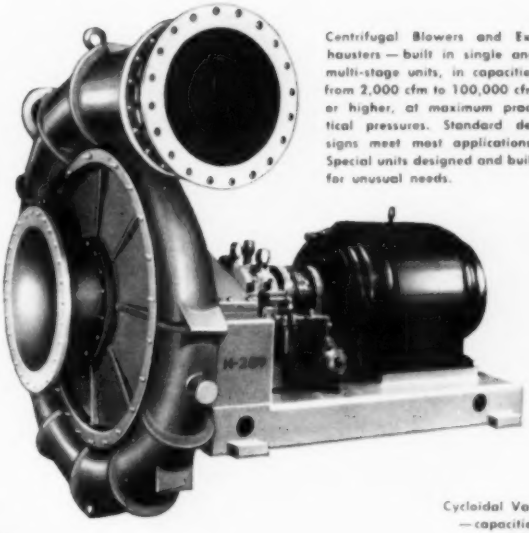
FOXBORO
Reg. U. S. Pat. Off.

For over 40 years, specialists in the measurement and control of temperature, pressure, flow, liquid level, humidity . . .

THE FOXBORO COMPANY • FOXBORO, MASSACHUSETTS, U.S.A.

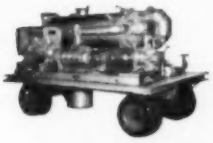


Rotary Positive Blowers and Exhausters — capacities 5 cfm to 50,000 cfm.



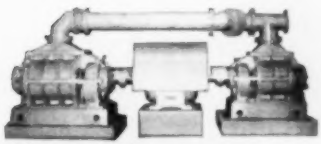
Centrifugal Blowers and Exhausters — built in single and multi-stage units, in capacities from 2,000 cfm to 100,000 cfm or higher, at maximum practical pressures. Standard designs meet most applications. Special units designed and built for unusual needs.

Rotary Positive Gas Pumps — capacities 5 cfm to 50,000 cfm.



Inert Gas Generators — capacities 1,000 cfh to 35,000 cfh.

Cycloidal Vacuum Pumps — capacities 500 cfm to 13,000 cfm.



Positive Displacement Meters — capacities 4,000 cfh to 1,000,000 cfh.

WE *Specialize* IN YOUR PROBLEMS OF MOVING GAS OR AIR!

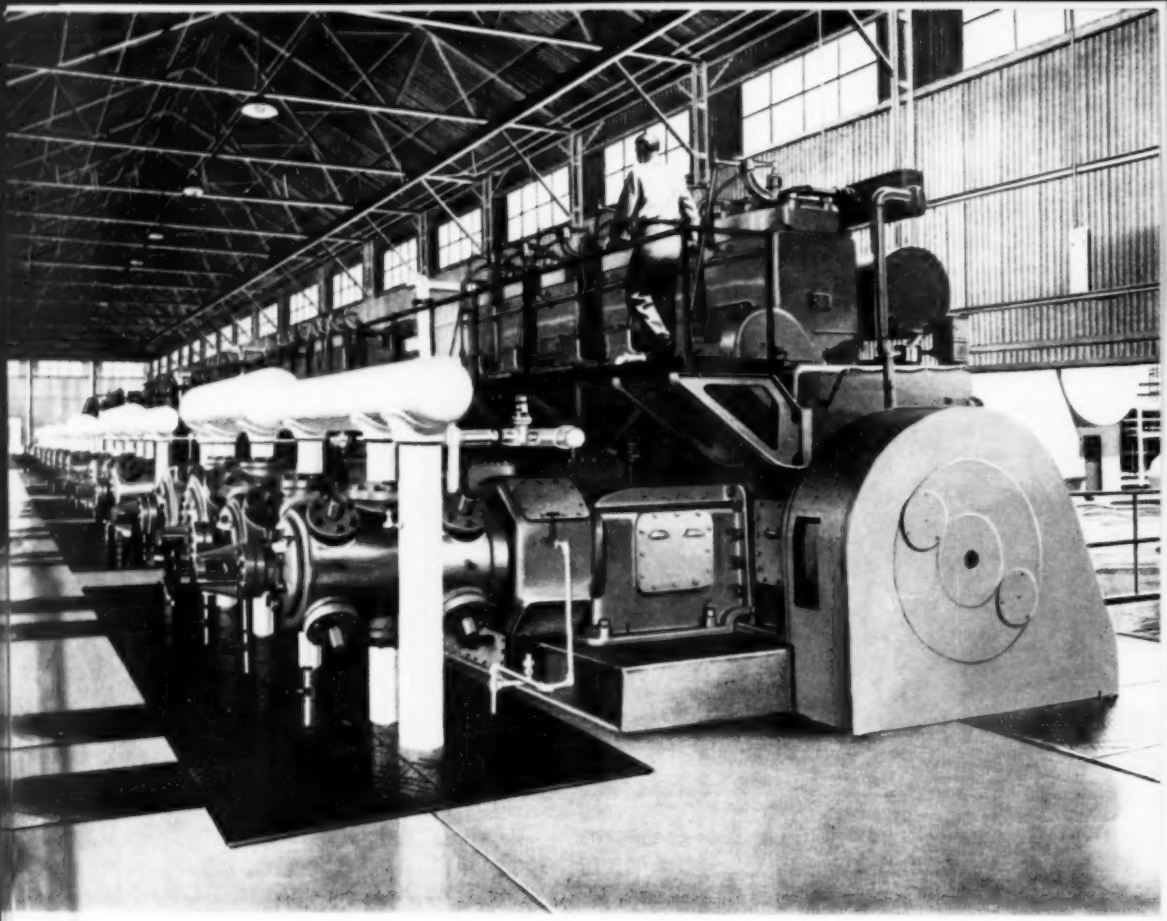
Your business probably is different when it comes to handling gas or air. You may want to move a thimbleful of gas — or create a cyclone of whirling air. But, no matter how your problem differs from your neighbor's, the chances are that we've met something pretty close to it, in our almost a century of experience.

Another reason why we know so much about this job is that it's all we do. Our customers range from the "giants of industry" to the neighborhood plant, both of whose production depends upon continuous, reliable, economical performance of air and gas handling units. Because we build the exclusive *dual-ability line* of Rotary Positive and Centrifugal Units, in a wide range of sizes, we offer a *dual choice* not available from any other maker — which permits completely unbiased recommendations.

So — if you have a problem today — or anticipate one a year or five years from now, we suggest you call upon the R-C Specialists — to give you a long-time, satisfactory answer. Write for bulletins on any specific equipment. *Roots-Connersville Blower*, A Division of Dresser Industries, Inc., Connersville, Indiana.

ROOTS-CONNERSVILLE

Exclusive Specialists in Handling Gas and Air



CLARK®

IS ONE OF THE DRESSER INDUSTRIES

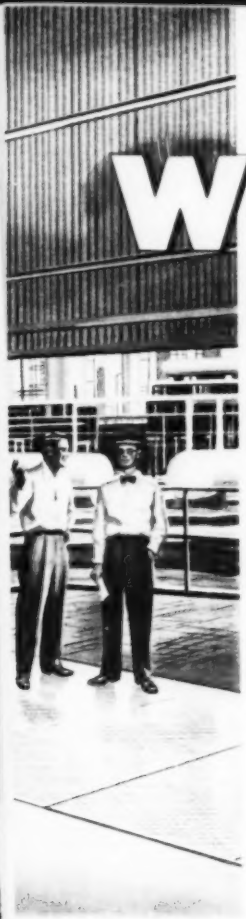
When the need is for heavy duty compressors, it is natural for industry to think of the leader in the field. Operating the largest and most modern plant in the world, for compressors and compressor prime movers, Clark Bros. is uniquely qualified to supply big units. Backed by forty years of experience, the Clark line today consists of every major type of compressor including gas, steam and diesel-engine driven units, motor driven units and centrifugal and axial flow types.

Magnet Cove Barium Corp., *Houston, Tex., Malvern, Ark., Greybull, Wyo.* Mag-cobar drilling mud, Mag-cogel bentonite, Mylogel, Fiber Seal, Jel-Oil mud.

Clark Bros. Co. Division, *Olean, New York. Offices in principal cities throughout the world.* Engines and compressors—gas, steam and diesel driven.

Dresser Manufacturing Division, *Bradford, Pa.* Oil and gas and pipe couplings, fittings and sleeves—rolled and welded rings—welding fittings and flanges.

Kobe, Inc., Division, *Huntington Park, Calif.* Complete hydraulic oil field pumping systems, including the Kobe Free Pump.



What is DRESSER INDUSTRIES

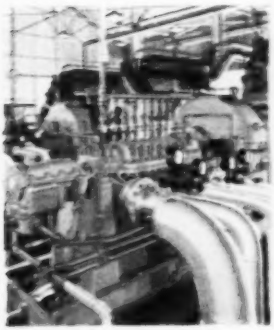
Dresser Industries, Inc. is one company—with the strength of many! A joint endeavor dedicated to producing the finest of integrated equipment and coordinated service for the oil, gas and chemical industries.

Each member company is an individual specialist and leader in its field. The parent, Dresser, incorporates many added services into its over-all administration, yet each company retains its individual identity and management. Such an integrated organization derives economies that are passed on to the operator along with the many other advantages of the specialized experience, know-how, research and development of each of these operating companies.

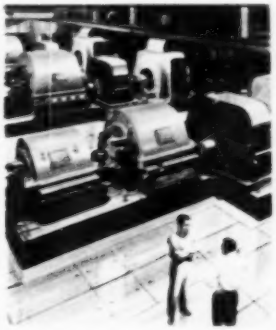
Dresser Industries is a vigorous, competent, far-reaching team to help meet efficiently the world's ever expanding energy requirements—a service unlimited—that makes your job easier, faster, more productive. This is your dividend from these combined operations—the DRESSER PLUS +

A large compressor installation represents a substantial capital expenditure. It calls for an unqualified management decision to choose the type of compressor best suited to the job. Building all types of compressors, Clark engineers can make truly unbiased recommendations for each job. Simple, rugged, highly dependable, Clark Compressors operate day and night around the world. For your next compressor application, specify Clark Compressors—and get "Precision by the Ton."

DRESSER INDUSTRIES, INC.
OIL, GAS AND CHEMICAL EQUIPMENT
ATLANTIC BUILDING ★ DALLAS, TEXAS

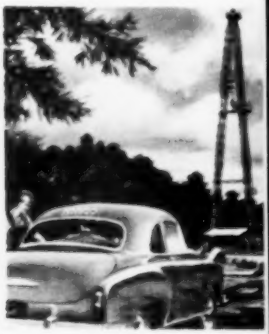


Pacific Pumps, Inc., *Huntington Park, Calif.* Centrifugal pumps, deep oilwell plunger pumps, hot oil and boiler feed pumps.



Roots-Connersville Blower Division, *Connersville, Ind.* Rotary positive blowers, gas pumps, centrifugal blowers, exhausters, positive displacement meters.

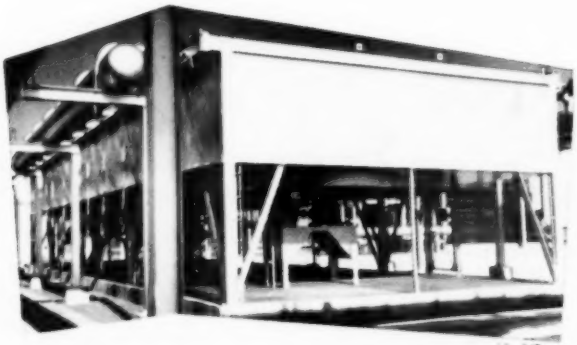
Security Engineering Division, *Whittier, Calif., Dallas, Tex.* Rock bits, reamers, casing scrapers, reamer rock bits, coring bits, Securalov.



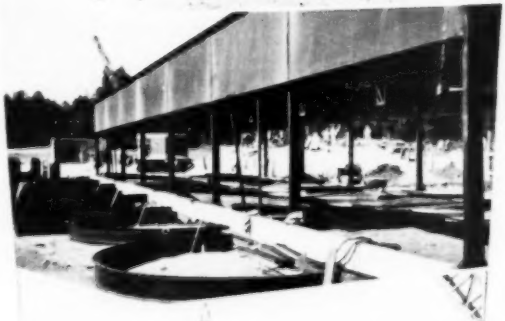
Ideco Division, *Dallas, Beaumont, Tex., Torrance, Calif.* Derricks, drawworks, rumbler drilling rigs, traveling blocks, rotary tables.

from the ground up,

MARLEY DRICOOLERS* are engineered for structural simplicity



Marley engineers designed DriCooler air-cooled heat exchangers with two objectives constantly in mind: stability and simplicity. That's why DriCoolers operate without the "shock and rock, quake and quiver" vibration often found in this type equipment. That's why field construction is no high-cost, long-time project. Every strong, sturdy element of the excellent DriCooler structure is completely prefabricated to facilitate erection. DriCoolers go up fast . . . and once erected stay there for long years of service.



This strength and simplicity are Marley plus values. The ability of DriCoolers to cool fluids and gases efficiently and economically is the primary reason for their selection by industry after industry. Flexibility of design for single or multiple service, and the wide range of sizes in *both* induced and forced draft models, fit DriCoolers to every industrial cooling operation. All are, of course, equipped with fans, drives and Geareducers designed and built by Marley exclusively for cooling service.

The engineering skill that produces DriCoolers is available to assist in their application to every type of installation. Just call the Marley man in your city or write Dept. DC . . . there is no obligation.

*Reg. Trademark

MARLEY

The Marley Company

Kansas City 5, Missouri

NEW ARQUADS

Save Money in Oil Recovery !

Reduce corrosion rate up to 99%
Effectively control bacteria and algae growth

Two new Armour products have proven extremely valuable in controlling both corrosion and bacterial-algae growth in oil recovery operations. Arquad S-2C and Arquad 2C have produced amazing results in solving two of the most troublesome problems of the industry, corrosion and the danger of plugging the sand face by corrosion products and bacterial-algae growth.

ARQUAD S-2C

In an eastern Oklahoma flood system, Arquad S-2C reduced the rate of corrosion 99.5%. In another system in eastern Kansas, the rate of corrosion was reduced 95% by the same chemical. Both sites reported complete bacteria and algae control.

Arquad S-2C is a surface-active quaternary ammonium compound, which is strongly adsorbed on metal surfaces, thereby protecting the surface from attack by corrosive liquids. Its powerful bactericidal properties have been verified by extensive laboratory and field tests.

ARQUAD 2C

This chemical is similar to Arquad S-2C in corrosion control properties, and is recommended for use where bacteria and algae growth do not offer extensive problems. For instance, a sour crude producing well in west Texas reported 93% reduction in rate of corrosion after introduction of Arquad 2C. Economy is one of the most important reasons for using this potent chemical, since corrosion control treatments cost about *one-half* the average of similar treatments using competitive inhibitors.

For your free copy of a new bulletin on control of corrosion and algae in oil recovery operations, fill out and mail the coupon today. At the same time, check the coupon for samples of both Arquads for your own testing and evaluation. Prices will be quoted on request.

"Arquad" is a trade name registered by Armour and Company

MAIL THIS COUPON TODAY

Gentlemen: Please send me the following:

☐ Tech. Bulletin E-6 ☐ Sample of Arquad S-2C ☐ Sample of Arquad 2C

Name_____

Title_____

Firm_____

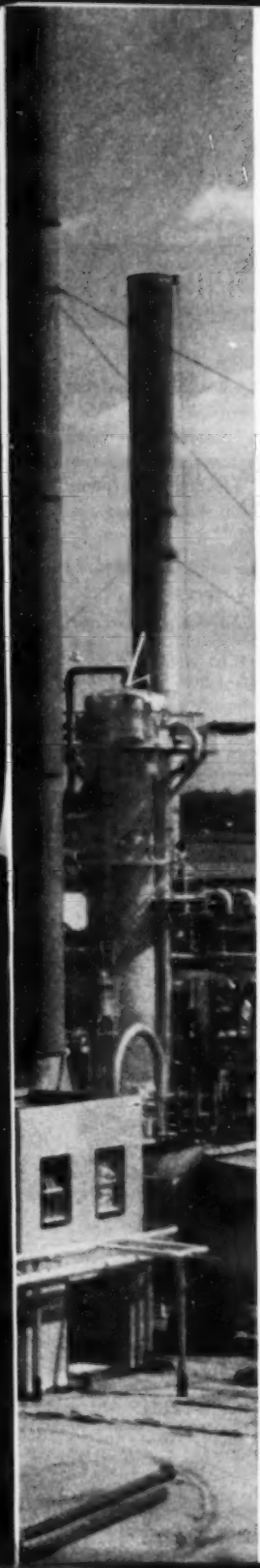
Address_____

City_____ Zone____ State_____

ARMOUR CHEMICAL DIVISION

Armour and Company • 1355 W. 31st St. • Chicago 9, Ill.

DID YOU KNOW THAT
UNIVERSAL SERVICE PROTECTS
YOUR INVESTMENT 7 WAYS?



UOP DESIGN AND ENGINEERING PROTECT YOUR INVESTMENT

In developing improved processing methods and techniques for the petroleum refining industry, Universal engineers translate ideas, laboratory research, pilot plant evaluations and engineering development into specific terms of plant design.

This complete detailing of the process units and accessory facilities demands the cautious coordination of all available data, the careful study of flow charts and constant surveillance of economy and efficiency factors.

The success of this approach is readily confirmed by the number of U.O.P. process units on stream and efficiently operating throughout the world — further evidence that Universal Service Protects Your Investment.

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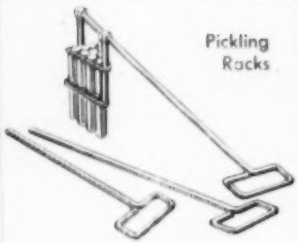
Universal Service Protects Your Investment through laboratory research . . . pilot plant studies . . . design and engineering . . . construction supervision . . . licensee instruction . . . post on-stream service . . . collateral services

Piston Rods

Bolts



Pickling Racks

Pump Shafts

HAYNES Alloy Bar Stock

Trade Mark

FOR SEVERE SERVICE CONDITIONS

Four different HAYNES alloys are available in hot-rolled and forged bar stock for the fabrication of parts subjected to heat, corrosion, or oxidation. Each alloy has an unusual combination of properties to combat certain severe service conditions, as indicated by the chart below. Typical parts made from HAYNES alloy bar stock are piston rods, valve stems, pickling racks, pump shafts, bolts, needle valves and forgings such as automotive valves and turbine blades.

Round bars are available in diameters from $3\frac{1}{2}$ in. down to $\frac{1}{4}$ inch. Rounds larger than $3\frac{1}{2}$ in. in diameter can be obtained as hot forgings.

HAYNES alloy bars can be turned, ground, drilled, tapped, reamed, threaded, and welded.

For further information about HAYNES alloy bar stock, contact the nearest Haynes Stellite Company district office.

USE BAR STOCK OF	FOR RESISTANCE TO
HASTELLOY Alloy B (nickel-molybdenum-iron)	Hydrochloric acid, wet hydrogen chloride gas, sulphuric acid, phosphoric acid, organic acids, high temperatures.
HASTELLOY Alloy C (nickel-molybdenum-chromium-iron)	Nitric acid, free chlorine, acid salts, hydrochloric acid, sulphuric acid, phosphoric acid, organic acids, sulphurous acid, high temperatures.
MULTIMET Alloy (cobalt-chromium-nickel-iron)	Oxidation, high temperatures.
HAYNES Alloy No. 25 (cobalt-chromium-tungsten-nickel)	Oxidation, high temperatures, carburization, wet chlorine, nitric acid.

HAYNES alloys

"Haynes," "Hastelloy," and "Multimet" are trade marks of Union Carbide and Carbon Corporation.

Haynes Stellite Company
A Division of
Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
Chicago — Cleveland — Detroit — Houston
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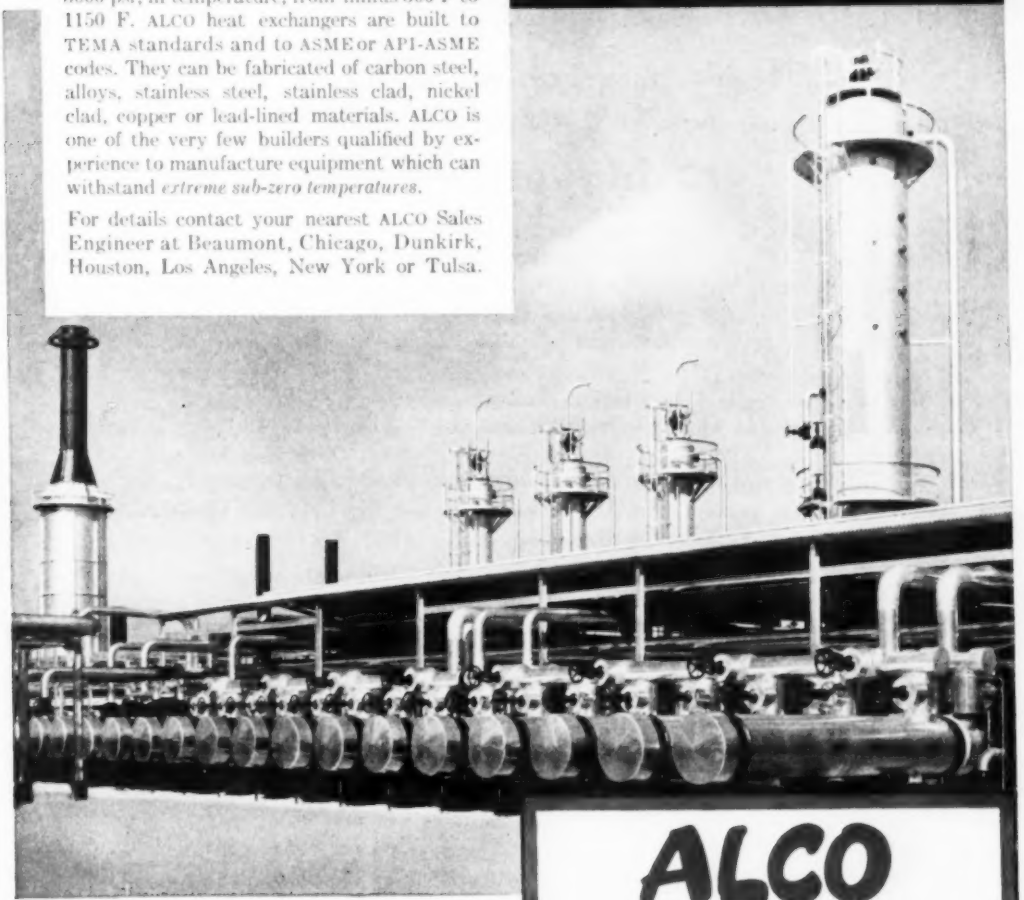
name your refinery equipment needs

Custom engineering... that's the secret of ALCO's success at meeting virtually all of the refining industry's many equipment requirements.

Rugged ALCO products have been produced to cover an extremely wide range of requirements. Units vary in diameter from four inches to twelve feet; in weight, from 100 to 300,000 pounds; in pressure, from high vacuum to 3000 psi; in temperature, from minus 300 F to 1150 F. ALCO heat exchangers are built to TEMA standards and to ASME or API-ASME codes. They can be fabricated of carbon steel, alloys, stainless steel, stainless clad, nickel clad, copper or lead-lined materials. ALCO is one of the very few builders qualified by experience to manufacture equipment which can withstand *extreme sub-zero temperatures*.

For details contact your nearest ALCO Sales Engineer at Beaumont, Chicago, Dunkirk, Houston, Los Angeles, New York or Tulsa.

piping
pressure vessels
heat exchangers
product filters
ALCO can meet them



ALCO
ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
Dunkirk, N. Y.

Can you name the 10 biggest oil companies?

If you can, you are also naming at least nine of the users of Carrier Centrifugal Compressors.

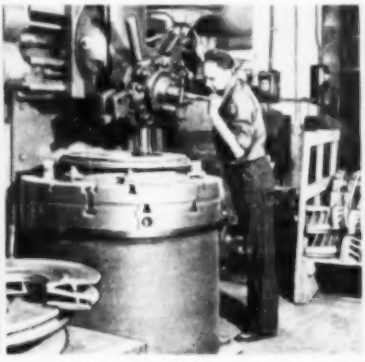
America's largest oil companies are well operated. When they invest millions of dollars in new facilities, they insist on rugged, reliable equipment throughout.

And that's the reason so many of them have selected Carrier Centrifugals. They know that Carrier has been building multi-stage centrifugal compressors for over 30 years . . . that over 2500 of them are now in use. They know that this kind of experience adds up to dependability.

If you'd like to know more, we'll be glad to send you our book, "Centrifugal Compressors for Industry." Write Carrier Corporation, Syracuse, New York.

Carrier

CENTRIFUGAL COMPRESSORS
REFRIGERATING EQUIPMENT

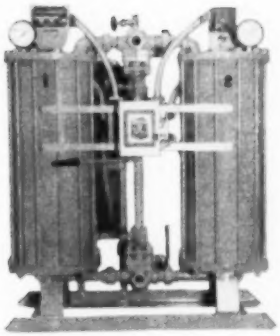


In the world's largest single plant devoted to manufacturing centrifugal compressors, many of the craftsmen who built the first Carrier Compressor thirty years ago still build and test them today.

On the Platte Pipe Line...

5 Lectrodryers at Cadoma, Wyoming 3 Lectrodryers at Wymore, Nebraska 1 Lectrodryer at Salisbury, Missouri

DRY air supplied by Lectrodryers* keeps automatic controls awake 24 hours a day



This type of Lectrodryer is used on the Platte Pipe Line; proved dependable in many years of service.

Designers who planned the Platte Pipe Line are taking no chances that moisture will get into instrument air lines and foul up controls. They feed DRY air to their instruments—air dried by Lectrodryers. There'll be no water in their lines to cause freeze-ups, form mud and rust to clog delicate instrument ports.

Lectrodryers catch the vaporous moisture which gets by aftercoolers, separators and filters. They're at work in petroleum refineries, chemical processing and power plants, as well as oil and gas pipe lines, all over the world. They're DRYing compressed air to low dew-points, keeping controls functioning properly.

Whether your moisture problem concerns instrument air, materials being processed or air in workrooms and storage areas, there are Lectrodryers to solve it. Write, telling your troubles with unwanted moisture, to Pittsburgh Lectrodryer Corporation, 332 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sydney.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U. S. PAT. OFF.

YOU CAN CUT CONTROL VALVE INVENTORIES *in half!*

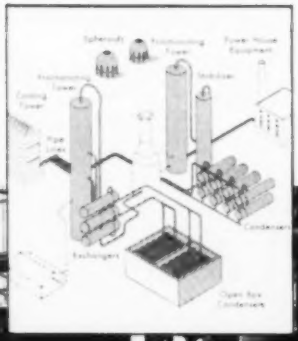
ONE ANNIN VALVE BODY FOR THREE TYPES OF ANNIN OPERATORS

A single Annin valve body is standard for use with any of three types of Annin operators. Furthermore, each size of operator fits two sizes of valve bodies. Think how your inventory of critical control valves can be cut. For any installation the valve body is selected by size and alloy, then assembled with operator desired, and your control valve is complete (positioner unit built-in)—ready for service under specified conditions. In addition, all valve bodies carry a 1000# rating. Interchangeable flanges series 15, 30 and 60 are split-ring mounted to meet any requirement. Write today for detailed information. Ask for Catalog 1500B.

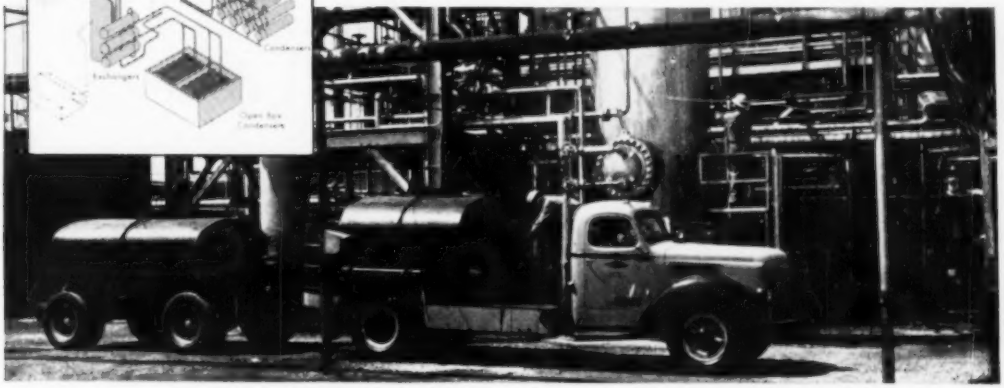
ANNIN CONTROL VALVES

THE ANNIN COMPANY 1000 Bridge Parkway, Los Angeles 32, Calif.

REFINERY EQUIPMENT CLEANED FASTER



Downtime Reduced, Unit Efficiency Restored through Chemical Cleaning by Dowell Service



Cleaning your refinery equipment—and keeping it clean—is a Dowell Service that adds up to more efficient and more profitable operation for you.

Here's why! Dowell Service can remove many undesirable deposits or coatings from the surface of a wide range of refinery equipment. In this way, Dowell Service protects the standard of your product . . . helps increase your production. And it aids you in maintaining designed unit efficiency.

Furthermore, through the use of chemical cleaning methods (instead of time-consuming mechanical means), Dowell Service is able to keep your down-time to a minimum. Solvents are pumped into equipment through regular connections—no dismantling is necessary. Truck-mounted equipment and trained engineers bring all necessary materials right to the job.

For the full story on Dowell Service, and how it can help solve your particular problems, be sure to get Dowell's illustrated booklet on refinery cleaning services. For your FREE copy, write today to: Dowell Incorporated, Dept. 211, Tulsa 1, Oklahoma.

Recent Dowell Service Results

Capacity Restored—Over 11,000 feet of 10 to 16-inch diameter fresh water service lines in an oil refinery were cleaned by Dowell Service. Result: Water lines were restored to designed capacity.

100% Scale Removal—Toluene unit (consisting of 3 large towers, several heat exchangers, lines and other equipment) cleaned by Dowell Service. Result: Unit completely cleared of hard scale deposit.

Through-put Increased—The Slurry-to-Feed heat exchangers in a fluid catalytic cracker were Dowell Serviced. Result: Company was able to increase through-put from 16,000 to 22,000 bbls. per day.

DOWELL SERVICE

Over 90 Offices to Serve You with Chemical Cleaning for:

Steam Generating Equipment • Towers • Tanks
Condensers • Heat Exchangers • Cooling Systems
Steam, Water and Product Lines • Water Wells

Chemical Services for Oil, Gas and Water Wells

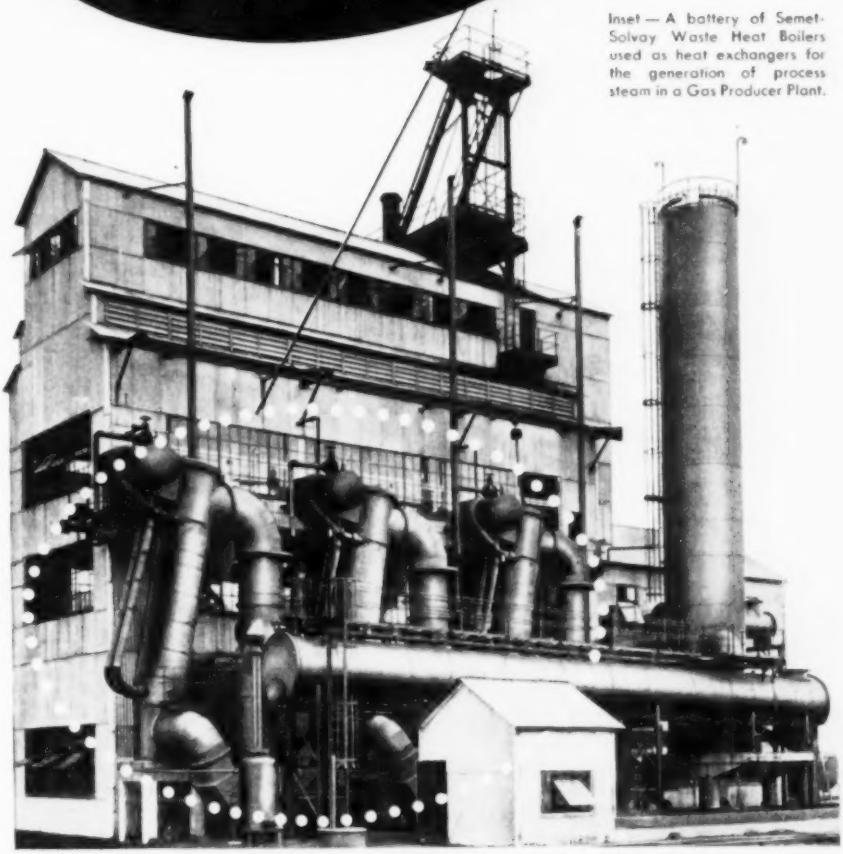
DOWELL INCORPORATED
Tulsa 1, Oklahoma

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

If better valves
could be made,
POWELL would make them
This is no idle boast because, for more than a century, Powell has been satisfying the demands of industry for the best valves it is possible to produce. As a result, Powell Valves have an enviable reputation for dependable service, long life and minimum maintenance.
The Wm. Powell Company
Cincinnati 22, Ohio
Fig. 1491.—Stainless Steel O. S. & Y. Gate Valve for 150 pounds W. P. Available in a variety of other corrosion-resisting metals and alloys. Also made with screwed ends.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

Here's how-



Inset — A battery of Semet-Solvay Waste Heat Boilers used as heat exchangers for the generation of process steam in a Gas Producer Plant.

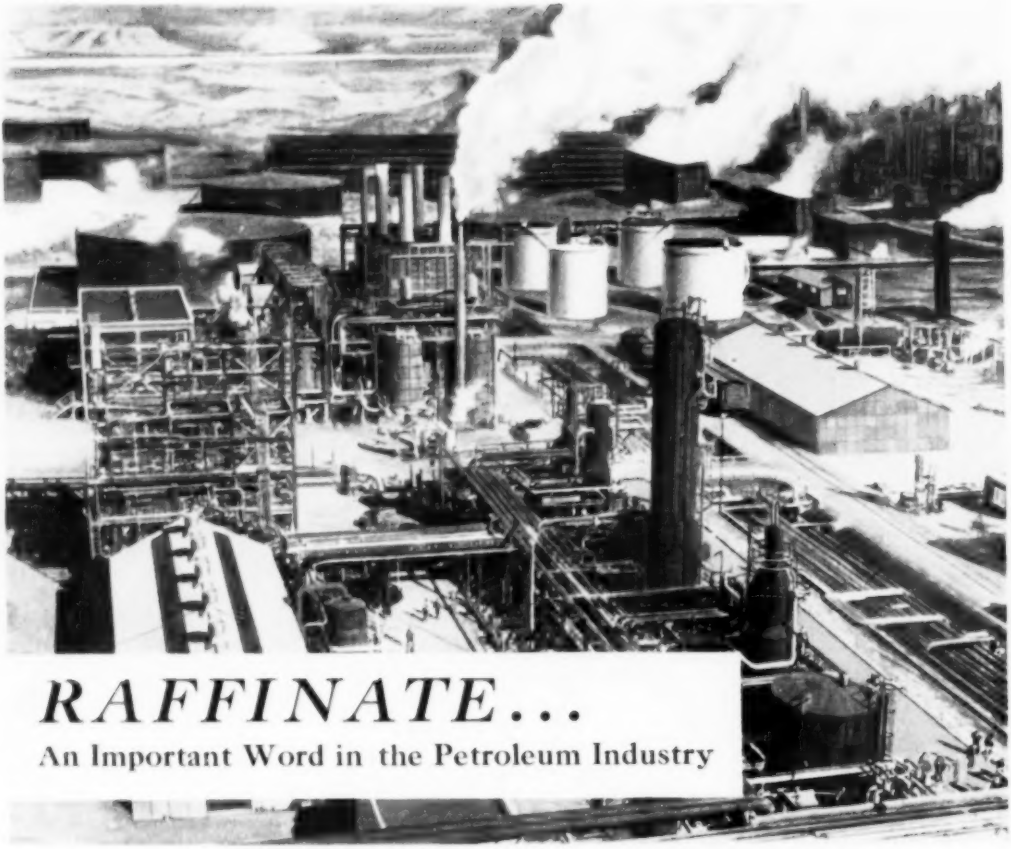
to put your "waste heat" on the payroll!

Have you a source of heat in your process that is going to waste? Now you can put these valuable Btu's to work by converting this heat into useful steam with a Semet-Solvay Waste Heat Boiler.

Efficient, with a high steaming rate and low maintenance cost, the Semet-Solvay Waste Heat Boiler is a packaged unit which is shipped ready for installation wherever large quantities of heat which otherwise would be wasted are available for absorption. A standard of comparison for over 20 years!

For additional information call or write today to—

SEMET-SOLVAY ENGINEERING DIVISION
40 RECTOR ST., NEW YORK 6, N.Y.
ALLIED CHEMICAL & DYE CORPORATION



RAFFINATE...

An Important Word in the Petroleum Industry

The SO_2 Extraction unit of the Phillips Petroleum Company at Phillips, Texas, shown in foreground above, is the second SO_2 plant to treat cat cycle stocks. Both plants were designed and built by Badger.

Catalytic cycle stocks, when extracted with SO_2, often give high yields of raffinates of a quality equal or superior to that of the virgin charge. These products may then be blended into premium diesel or similar fuels or reprocessed in the cat cracker with minimum coke.

STONE & WEBSTER ENGINEERING CORPORATION

BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS (GREAT BRITAIN) LTD.

HERE'S THE RIGHT COMBINATION FOR High-Temperature Bolting

For high-temperature, high-pressure bolting, you need fasteners that resist premature fatigue-failure; fasteners that pay for themselves by staying on the job, day in, day out. And here's the right combination to use—the Bethlehem Continuous-Thread Stud, together with two Bethlehem Quenched Nuts.

The Bethlehem Continuous-Thread Stud is ideal for high-temperature, high-pressure bolting because it has every requisite for long, economical service. The accurately made stud has no point of thread-runout. Severe stresses can't gather at any one point on the stud, but are distributed over the full length.

The Bethlehem Quenched Nut is a fitting companion to the Continuous-Thread Stud. It is a superior nut in every way. It is made from .40 to .50 carbon steel. The nut is forged and extruded in a forming die, then quenched and tempered. This method makes the nut so strong that it can break almost any stud or bolt on which it is used!

Both the Bethlehem Continuous-Thread Stud and the Quenched Nut come in a wide range of sizes. If you would like to have full information, we suggest you get in touch with the nearest Bethlehem office.

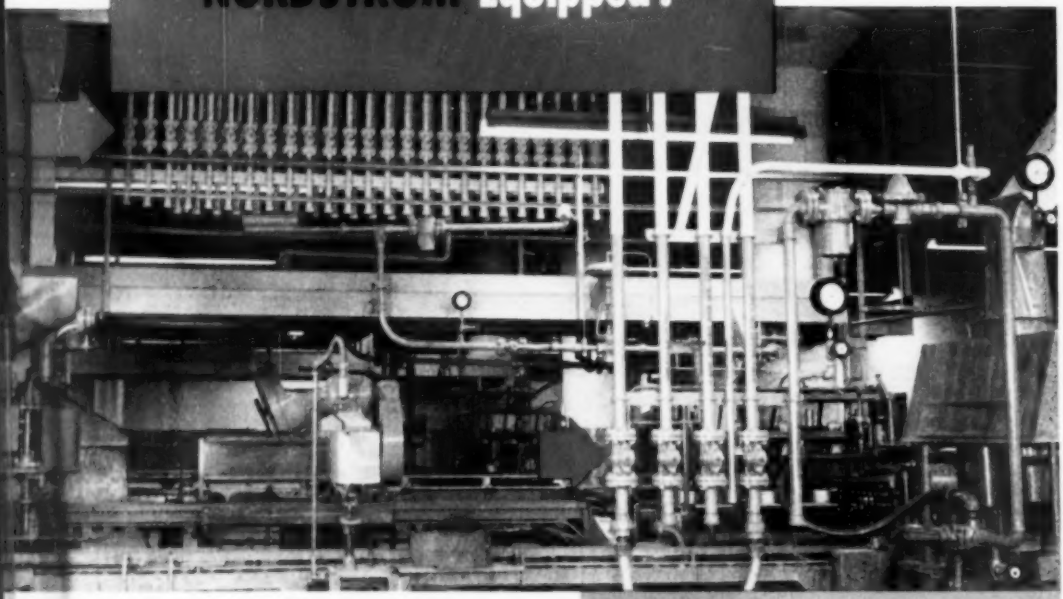
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

★ BETHLEHEM STEEL ★

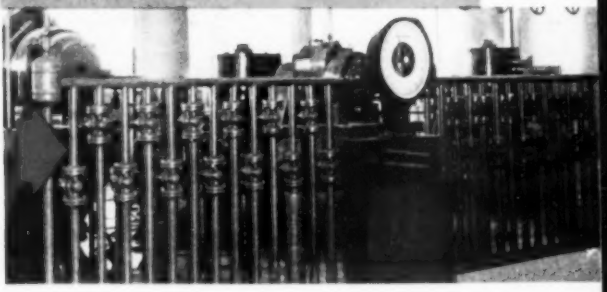
Bethlehem supplies every type of Fastener

Q: Why are Grease Plant Lines So Often NORDSTROM Equipped?



Every line in this grease plant barrel-filling unit is controlled by Nordstrom valves.

Manifold of grease plant packaging department lines completely Nordstrom-equipped.

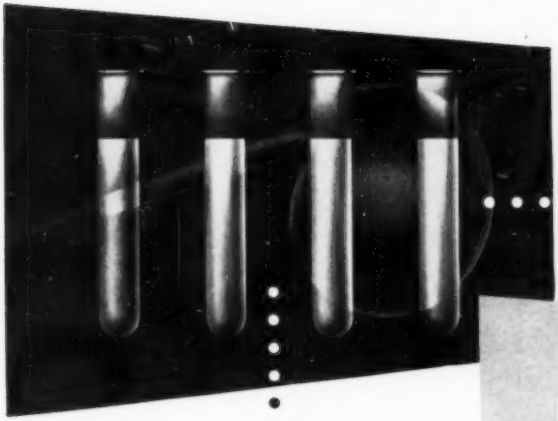


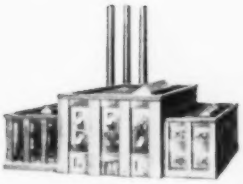
A: Grease Plant Operators Know the Value of Lubrication

Men who devote their lives to the study of greases and lubricants realize that where metal-to-metal friction occurs, lubrication is *essential*. Unprotected metal surfaces soon wear; a film of lubricant is a must for three important reasons—resistance to wear, ease of operation, tight sealing.

Nordstrom valves—with a tested lubricant for every type of service—mean trouble-free, efficient operation. Your maintenance costs can be reduced; valve replacement virtually eliminated by installing Nordstroms throughout your plant. Write for data on the type of valve and lubricant best suited to your services. Rockwell Manufacturing Company, 400 N. Lexington Ave., Pittsburgh 8, Pennsylvania.

ROCKWELL Built
Nordstrom Valves





Here's a sure way to control carryover and blowdown

Impure steam and excessive blowdown are two "bugaboos" that need not be tolerated by any power plant engineer, thanks to effective anti-foam agents.

Within recent years, the Betz Organization has developed several anti-foam agents which have produced remarkable results both from a standpoint of better boiler operation as well as direct savings.

For instance, a large midwestern plant operated at 250 pounds pressure and used boiler feedwater softened by the hot lime soda process. The river water used as make-up at this plant varied widely in composition and was contaminated by a number of industrial wastes. Highly impure steam was produced with boiler water concentrations of approximately 3,000 ppm.

After analysis, Betz Engineers applied properly formulated anti-foam agents to this problem. Boiler water concentrations were raised to the extremely high value of 16,000 ppm before a similar steam impurity developed!

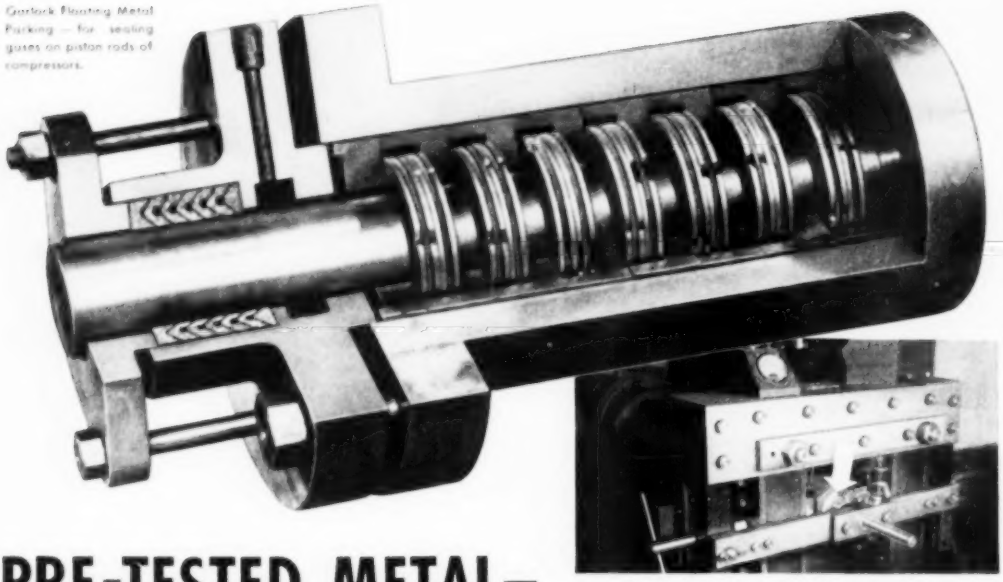
The positive control of carryover and boiler blowdown is only one of the many services extended by the Betz Organization. Let us explain to you how our *complete* engineering guidance can help you solve all your water problems. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal I.

For the complete story on carryover and blowdown control through the use of anti-foam agents, write for Technical Paper No. 115.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

Garlock Floating Metal Packing — for sealing gases on piston rods of compressors.



PRE-TESTED METAL—

Your assurance that Garlock Metal Packings are right for the job!

Above: Arrow points to foundry specimen being wear tested on specially designed machine.

Designed specifically for high pressure and high temperature service to seal air, ammonia, steam or any gas on piston rods of compressors and steam engines, Garlock Metal Packings are quality-controlled throughout their entire manufacture.

Starting with the metals of construction, every "heat" of cast iron and bronze is accelerated-wear-tested on a special machine by an independent organization before the materials are shipped to Garlock. If the wear test specimen does not pass Garlock's rigid standards, then the entire "heat" is rejected.

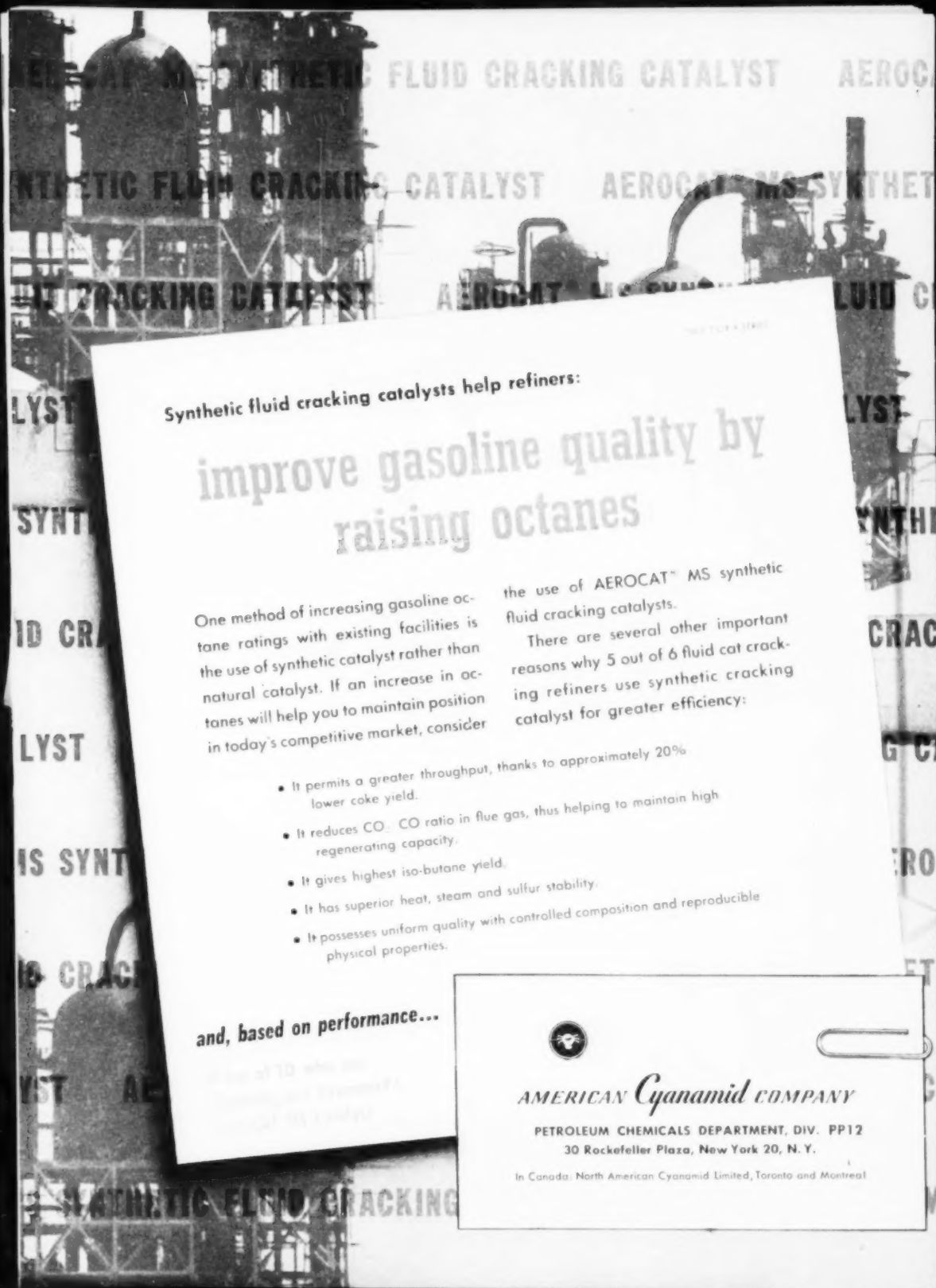
Then, using these tested, high-grade materials, Garlock Metal Packings are accurately machined to exacting specifications by experienced craftsmen. Throughout every operation extreme precision is the watch-word.

The product of this rigid pre-testing and precision manufacture is a metal packing that you can be sure will meet your service requirements. So, standardize on Garlock Metal Packings—they last longer, require less maintenance.

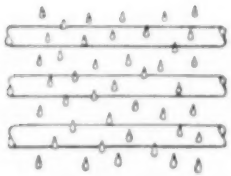
THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

Tulsa, Okla. Houston, Tex.
Los Angeles, Calif.

GARLOCK FLOATING METAL PACKINGS


FLUID CRACKING CATALYST
AEROCAT MS SYNTHETIC
CATALYST
AEROCAT MS SYNTHETIC
FLUID CRACKING CATALYST
Synthetic fluid cracking catalysts help refiners:
improve gasoline quality by raising octanes
One method of increasing gasoline octane ratings with existing facilities is the use of synthetic catalyst rather than natural catalyst. If an increase in octanes will help you to maintain position in today's competitive market, consider the use of AEROCAT™ MS synthetic fluid cracking catalysts.
There are several other important reasons why 5 out of 6 fluid cat cracking refiners use synthetic cracking catalyst for greater efficiency:
• It permits a greater throughput, thanks to approximately 20% lower coke yield.
• It reduces CO2/CO ratio in flue gas, thus helping to maintain high regenerating capacity.
• It gives highest iso-butane yield.
• It has superior heat, steam and sulfur stability.
• It possesses uniform quality with controlled composition and reproducible physical properties.
and, based on performance...
AMERICAN Cyanamid COMPANY
PETROLEUM CHEMICALS DEPARTMENT, DIV. PP12
30 Rockefeller Plaza, New York 20, N. Y.
In Canada: North American Cyanamid Limited, Toronto and Montreal

Which condenser gives greatest sub-cooling?

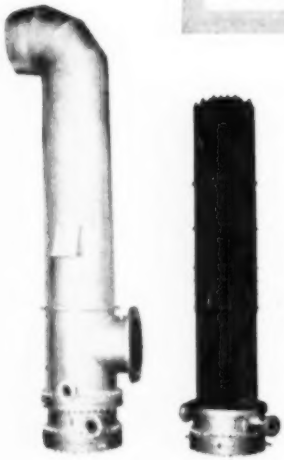


A

Diagram of part of a standard horizontal tubular condenser. Here, the drops of condensate hop, skip and jump down over the bare tubes, with only momentary contact at each tube.

B

Diagram of one of the finned elements of a G-R G-Fin Vertical Condenser. Here, the drops of condensate are guided along the channels formed by each of the G-Fins, so that they are in constant contact with the tubes throughout their entire downward flow.



These two diagrams show why the G-R G-Fin Vertical Condenser provides far greater sub-cooling effect than horizontal bare tube units for condensing hydrocarbon vapors.

One of the many other important features of this G-R design is that the absence of a floating head at the top of the unit permits unobstructed entrance of vapors. This feature makes the G-Fin Condenser the most economical design for high vacuum service.

Write for complete information on the design that provides exceptional compactness, low pressure drop, freedom from temperature strains, and prevention of condensate entrainment as well as superior results in high vacuum service and greatest sub-cooling effect.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

G-R HEAT TRANSFER APPARATUS

G-Fin Condenser

ONE OF THE MANY TYPES OF G-R HEAT TRANSFER APPARATUS

The practical way to save pipes, tanks, derricks, buildings, pumps, roofs, fences

STOP RUST! with RUST-OLEUM

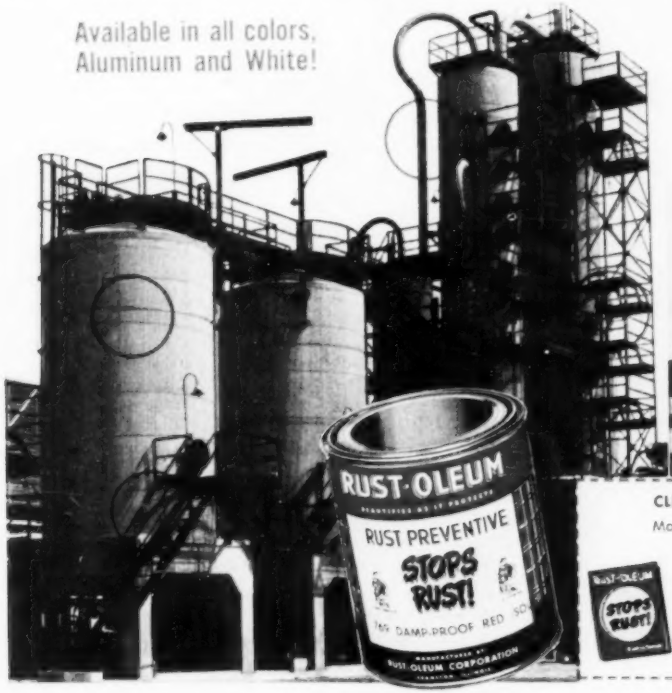
RUST-OLEUM is the *practical, sensible* answer to your rust problems. Cuts your maintenance costs, because it may be applied *directly over rusted surfaces* after wirebrushing and scraping with sharp scrapers to remove rust scale and loose particles . . . costly sandblasting and chemical pre-cleaning are not usually required. This often enables *one man* to do the work of two with RUST-OLEUM! Practical, too . . . because RUST-OLEUM beautifies as it protects in *all colors, aluminum,* and *white.*

We'll be happy to show you convincing proof that RUST-OLEUM can cut your maintenance costs . . . and last longer when applied over rusted surfaces. Get the facts, today! Prompt delivery from Industrial Distributor stocks in principal cities in the United States and Canada.

RUST-OLEUM CORPORATION
2476 Oakton Street, Evanston, Illinois

May be applied directly over rusted surfaces without removing all the rust!

Available in all colors, Aluminum and White!



See Rust-Oleum Demonstrated Booth 1237, Plant Maintenance Show, Cleveland, Ohio

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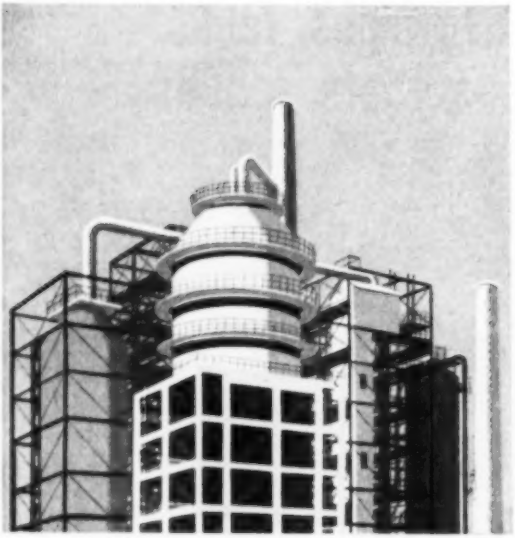
- ☐ Complete Literature
- ☐ Nearest RUST-OLEUM Source



Top Performance from Cat-Cracker Regenerators

A CAREFUL STUDY OF THE REGENERATION DATA FROM CATALYTIC CRACKING INDICATES THAT OXYGEN DISAPPEARANCE (USUALLY CALLED HYDROGEN IN COKE) INCREASES WITH INCREASING CARBON ON REGENERATED CATALYST. ABILITY TO CRACK GAS OIL, AS WELL AS GIVE GOOD GASOLINE TO CARBON RATIOS, DROPS RAPIDLY WITH INCREASING CARBON ON REGENERATED CATALYST; HENCE THE CATALYST THAT REGENERATES MOST EASILY CAN SHOW REAL ADVANTAGES. BY ITS NATURE, FILTROL'S CATALYST FLUID 58 HAS A FASTER REGENERATION RATE IN COMMERCIAL OPERATION THAN OTHER CATALYSTS IN GENERAL USE. THE BETTER REGENERATION RATE RESULTS IN BETTER OXYGEN UTILIZATION, HIGHER GASOLINE-CARBON RATIOS AND GREATER RETURN FROM CAT CRACKING OPERATIONS.

ORSAT ANALYSIS	FILTROL* CATALYST FLUID 58	OTHER CATALYSTS
%CO_2	11.8	9.5
%CO	5.7	7.3
%O_2	1.7	.25
CARBON BURNED, # HR.	18,500	17,900
HYDROGEN IN COKE	8.4	9.6
CARBON ON REGEN. CAT.	0.3	0.6

1.51

THE FIGURES SHOW THAT CO_2/CO RATIO IS NOT THE CRITERION OF REGENERATION CAPACITY.

OTHER REASONS FOR USING FILTROL CATALYSTS:

1. Higher octane barrels
2. High butylene yield
3. Low cost
4. Sulphur resistant catalysts
5. Technical assistance
6. Varied plant facilities
7. Uniformity
8. Lowered excess butane
9. Low attrition rate

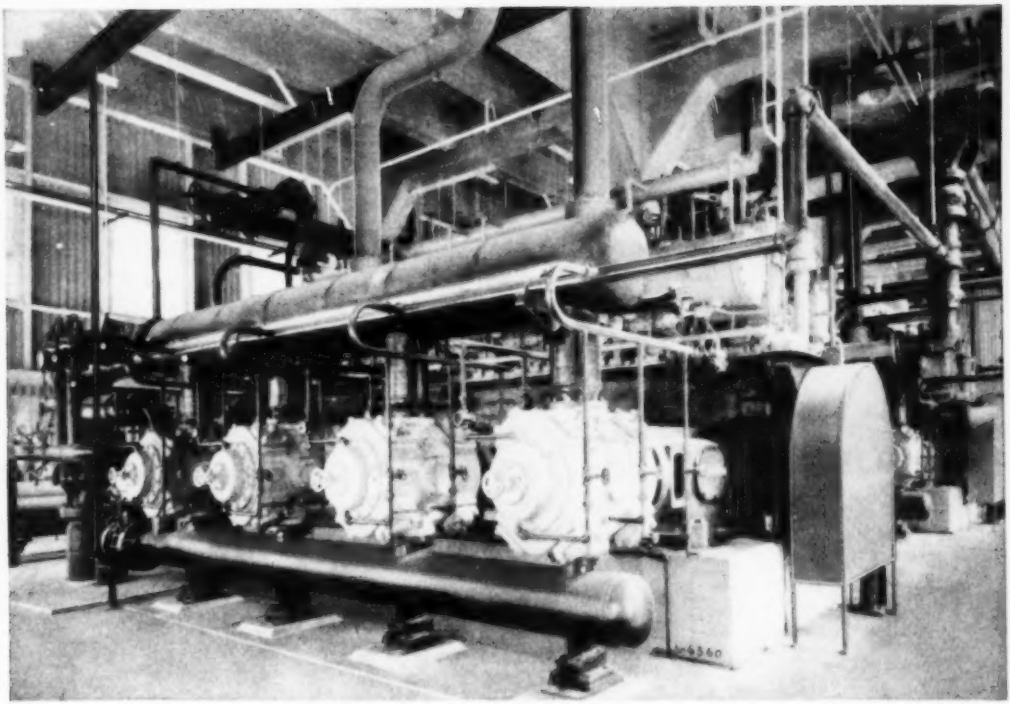
Filtrol*

FILTROL CORPORATION

OFFICES: 727 WEST SEVENTH ST., LOS ANGELES 17, CALIFORNIA
PLANTS: VERNON, CALIF.; SALT LAKE CITY, UTAH; JACKSON, MISS.

CATALYSTS AND ADSORBENTS

*Reg. U.S. Pat. Off.



WORTHINGTON ANGLE GAS-ENGINE COMPRESSOR installation in a gas pipeline pumping station.

Now . . . more horsepower, higher efficiency in Worthington Angle Gas-Engine Compressors

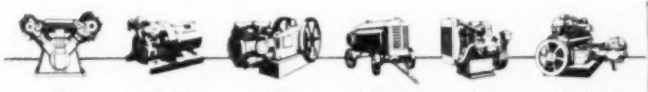
New LTC-H compressor has all advantages of famous LTC plus high compression

This new Worthington LTC-H Angle Gas-Engine Compressor—the latest Worthington advance in its engine-compressor design—is typical of the kind of improvement achieved by Worthington engineers throughout many years of leadership in the manufacture and application of compressors and large internal combustion engines.

The new high-compression engine-compressor has considerably higher horsepower ratings than its well-known predecessor, the LTC, but runs cooler and on less fuel. LTC-H users will find the new unit is built to give the same day-in, day-out service that has given all Worthington Engine-Compressors a reputation for extreme dependability throughout the gas, petroleum and chemical worlds in *pipeline pumping, refinery operations, public utility gas distribution,* and service in *natural gasoline and pressure maintenance plants, petro-chemical and synthesis plants,* and *refrigeration plants.*

Write for more information on this latest development in Bulletin L-690-B1B or let us know that you're interested in conversion of your present unit. Worthington Corporation, Compressor Division, Buffalo, N. Y.

K-2.16



NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON

WORTHINGTON

Engine Compressors

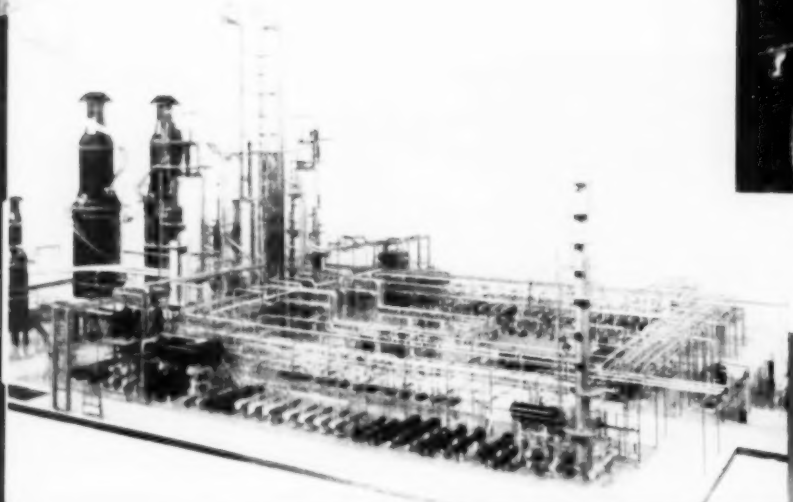
REFINERY *through a* NEEDLE'S EYE

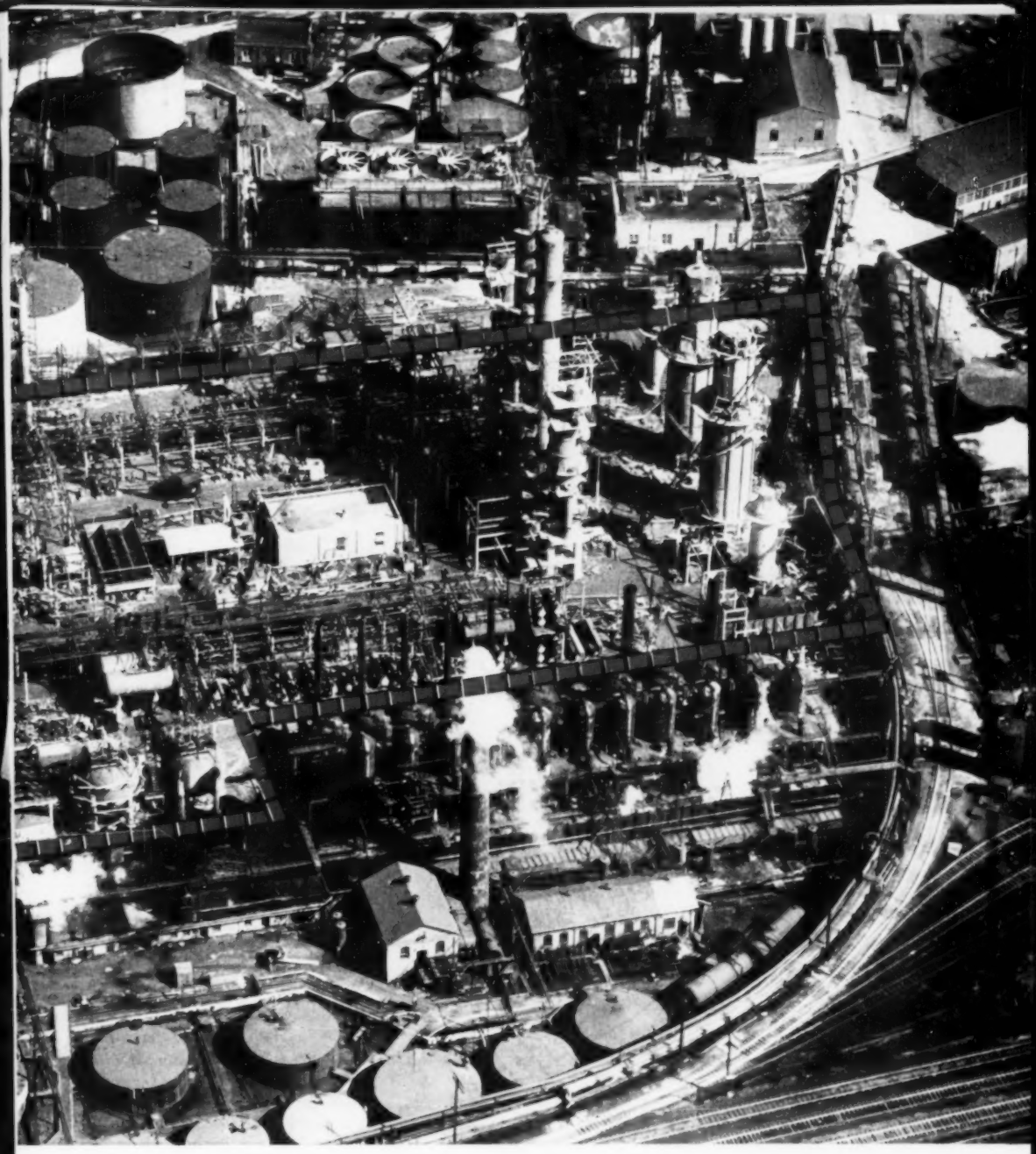
HUNDREDS of tons of material and equipment for this 50,000-barrel twin distillation unit had to be brought in "through a needle's eye." Only one narrow avenue of access was open during much of the construction time and the unit itself occupied practically all of the site leaving very little elbow room for maneuvering equipment or for storage of materials.

These conditions demanded precise timing of the arrival of materials and equipment and rigid adherence to a carefully planned construction schedule.

The twin unit was recently completed for The Standard Oil Company of Ohio on the original site of their No. 1 Refinery in Cleveland. It is operating successfully today—another proof that *McKee Engineering means assured results.*

This scale model of the unit helped check engineering and speed construction. It is a valuable aid in training operating and maintenance crews.





DESIGN, ENGINEERING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES

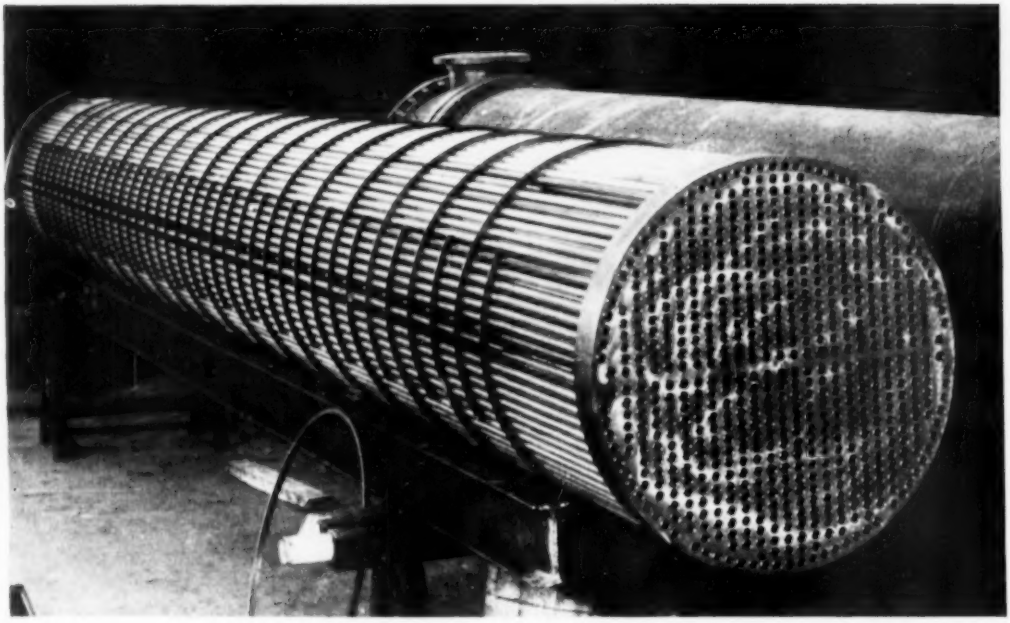
McKee Engineering

Arthur G. McKee & Company • Established 1905

Headquarters: McKee Building, 2500 Chester Avenue, Cleveland 1, Ohio. *New York Office:* 30 Rockefeller Plaza, New York 20, N.Y. • *Washington Office:* 1507 M Street, N. W. Washington, D. C. • *England:* The Iron and Steel Division of Arthur G. McKee & Company is represented by Head, Wrightson & Company, Ltd. *District Engineering Offices:* Union, New Jersey and Tulsa, Oklahoma

for cooling lube oil
economically
they use the oil industry's
favorite tube alloy

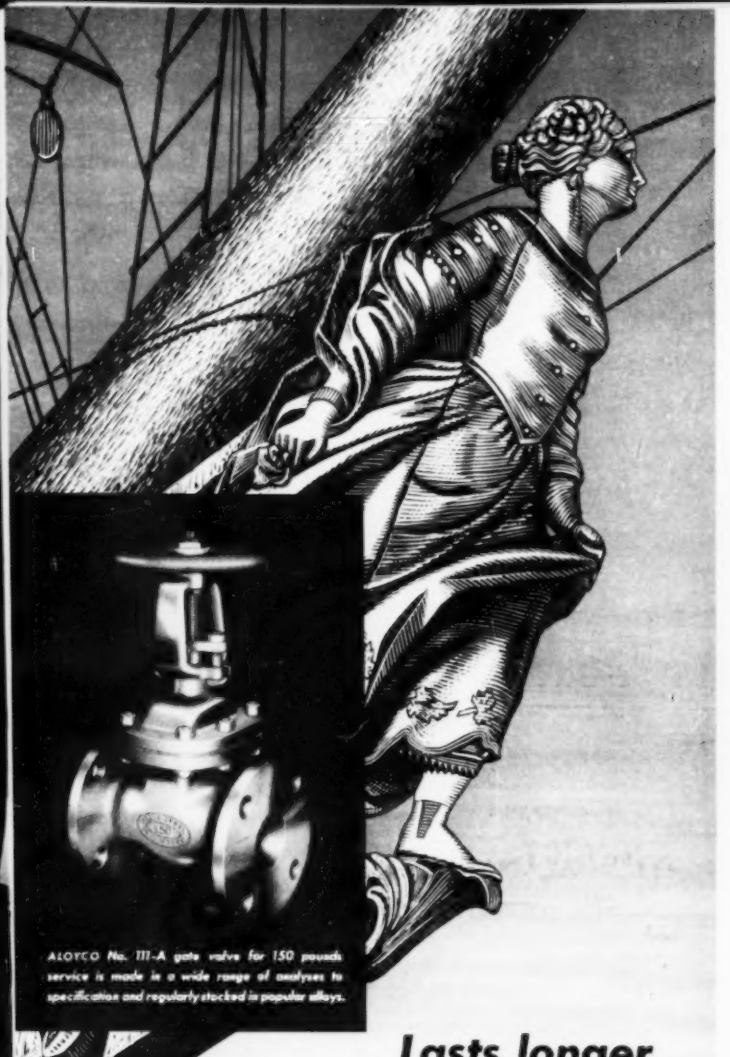
ARSENICAL ADMIRALTY-439
Tubes (¾ in. O.D. x .049 in. x 16 ft.) were used in this heat exchanger—898 lengths! Kewanee-Ross Corporation made it to cool lubricating oil in a hot strip mill. Here, where corrosive and erosive factors are only moderately severe, this alloy was selected as the most economical.



WHY REFINERIES CHOOSE THIS ALLOY — Arsenical Admiralty-439 is the standard tube alloy for condensers and heat exchangers handling crudes, re-run stocks, cracked products, lubricating oils and by-products. It satisfactorily resists gas streams from both sweet and sour crudes (with or without neutralizers), general corrosion, and also dezincification. This latter feature makes it ideal for handling corrosive cooling waters at relatively high temperatures.

CASE HISTORIES — Anaconda's Technical Department has accumulated extensive data relating to the actual performance of copper alloys. It is always prepared to use this practical knowledge to assist you in selecting the right alloy for your application . . . to help you get longer tube life at lower operating cost. For this service write The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

for efficient heat transfer—ANACONDA® condenser tubes



ALOYCO *No. 111-A gate valve for 150 pounds service is made in a wide range of analyses to specification and regularly stocked in popular alloys.*

Lasts longer in corrosive service

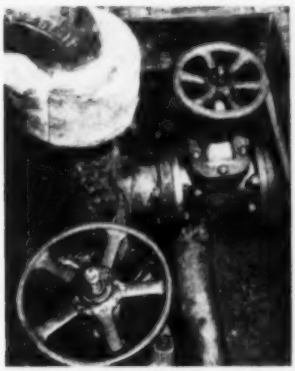
This bolted bonnet type gate valve, made to specification, provides the three basic advantages of all ALOYCO valves . . . (1) special engineering for severe corrosive service through (2) extensive metallurgical research and (3) production of high alloy valves exclusively.

NINE years of low-cost valve operation despite severe service

It takes mighty tough valves to make a record like that, especially when they're used in sulfuric acid manufacturing under temperatures up to 140 F, pressures up to 150 psi, acid concentrations above 65%.

Such is the case at the Chemico plant of the Bayway Refinery of the Esso Standard Oil Company—and such is the performance of the Teflon-packed ALOYCO 20 gate valves used there.

The type of valves formerly used frequently became inoperable because their working surfaces corroded. Not their ALOYCO successors! They're operating easily, with low maintenance. Since they're Teflon-packed, even leakage at the packing point has been eliminated.



ALOYCO No. 111-A Teflon-packed gate valves give repair-free service on sulfuric acid line in petroleum refinery.

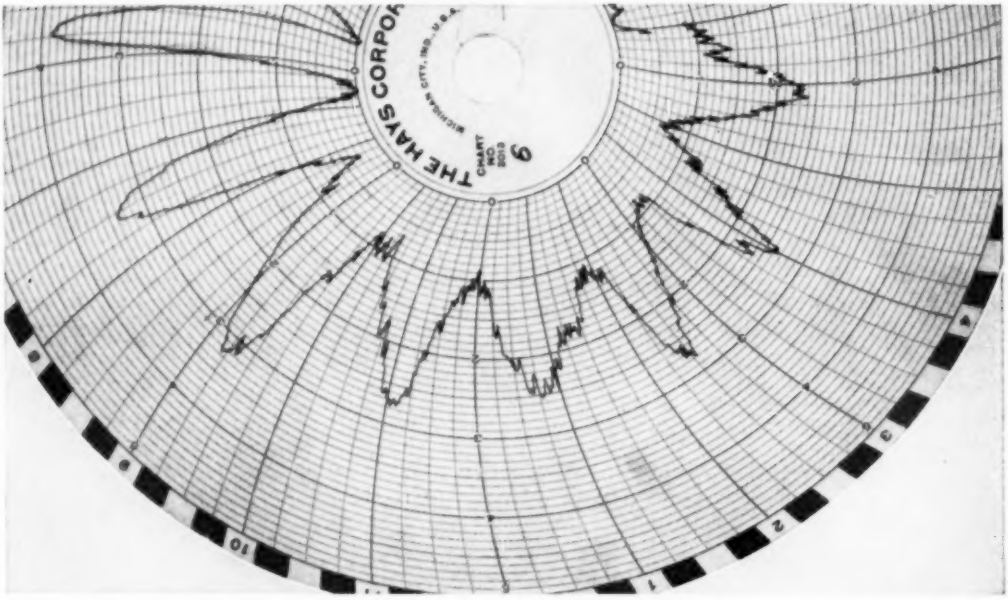
What's the secret of this superior performance? Simply this: ALOYCO is the *world's largest specialist* in high alloy valves engineered to counteract specific corrosives, devoting itself *exclusively* to "diagnosis" and "treatment" of such problems. After laboratory and field testing, the ALOYCO corrosion engineers specified ALOYCO 20 for Chemico—a special alloy of chrome-nickel-molybdenum outstanding in resisting sulfuric acid.

The same kind of success story can be yours, if you consult ALOYCO on how to handle severe corrosives or guard against product contamination.

ALLOY STEEL PRODUCTS CO., INC.
1324 West Elizabeth Avenue, Linden, N. J.

Longer Lasting
ALOYCO VALVES
1st in Corrosive Service

Portrait of a "team" at work



Swings show efforts of new crew before catalyst regenerator was brought to point of operation through use of Hays Magno-Therm O_2 Recorder. Note that swings are smaller at right of chart indicating that stability is being approached.

The chart illustrated above was produced during the starting-up period of a new catalyst regenerator. The wide "swings" on the chart graphically illustrate the efforts of the "team"—a new crew and their Hays Magno-Therm Oxygen Recorder—to operate the unit efficiently. Their problem: To achieve continuous, stable operation thus avoiding "after burning" (excess O_2) which would damage the catalyst and the regenerator as well as too little burning (deficient O_2) which would not effectively regenerate the catalyst.

Solution

Answer to this problem was the "team" operation by crew and Hays Magno-Therm Oxygen Recorder. The "team" now maintains the O_2 content of the effluent gases between .5% and 2.0% thereby producing effective catalyst without damaging the multi-million dollar installation.

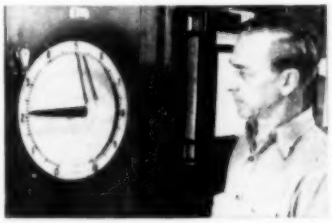
The operating crew could do this because the Magno-Therm O_2 Recorder reflects, without lag and in a direct and magnified manner, changes in the amount of excess air present, thus making control a simpler task. No longer need the crew attempt to operate with only indirect, small temperature changes as a guide.

For process heaters and boiler plants

The Hays Magno-Therm Oxygen Recorder has also been successfully and *profitably* applied to process heaters and refinery boiler rooms where multiple fuel firing is a problem.

With the Hays Magno-Therm Oxygen Recorder you get:

• Freedom from effect of varying Hydro-Carbon ratios of different fuels • Continuous, highly accurate indication and recording • Complete compensation for temperature and pressure effects • Freedom from chemicals or hazardous fuel burning in the analyzing process • Swift, sure electronic operation



Hays Bulletin 51-829 tells the complete story of the Magno-Therm. Write for it.

THE **HAYS** CORPORATION
MICHIGAN CITY 23, INDIANA

Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters
VeriFlow Meters and Veritrol • Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

POSITIVE CAM ACTION

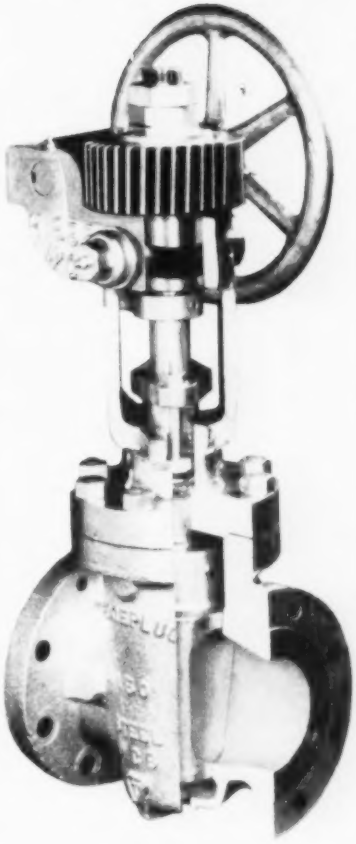
Eliminates "Stuck Valves"

Wedgeplug Valves have established an enviable record of trouble-free operation and dependability, regardless of service, temperature, or pressure. The Wedgeplug Principle—which is the application of power through a simple, patented cam mechanism—assures a quick, positive lift of the tapered non-lubricated Plug from its raised seating surfaces; a 90 degree turn; and, then, a lowering and tight re-seating of the Plug—all accomplished in sequence, and in one operation by a few turns of a handwheel.

NON-LUBRICATED

Wedgeplug Valves are non-lubricated. They do not depend on a lubricant to prevent the Plug from sticking. The operation of Wedgeplug Valves is a positive one, which fact does away with the problem of "stuck valves". The operator is always in control of the line.

Quick, positive, trouble-free operation at any temperature and pressure; ease of adjustment while the valve is in service in the line; protection against any erosion or corrosion of the vital, raised seating surfaces in both open and closed positions; high unit seating pressures; large port openings that assure minimum restrictional loss, even at low pressures; the scientific design, and experimentally proven taper of the Plug and its seat; together with the fact that no lubricants and wasteful manhours are required—are some of the reasons for the ever-growing popularity of Wedgeplug Valves for general service in refineries. Adaptable for operation by remote control. Priced to compete with conventional-type Plug Valves. Write for Wedgeplug Catalog No. 52W.

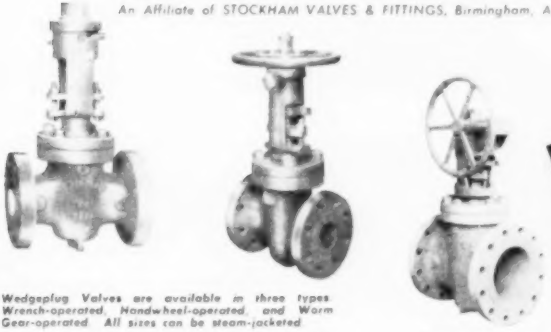


A DRY PLUG VALVE THAT LIFTS—TURNS—AND RESEATS IN ONE SINGLE, POSITIVE, CAM ACTION WITH A FEW TURNS OF THE HANDWHEEL.

WEDGEPLUG VALVE CO., INC.

1306 S. BROAD AVENUE, NEW ORLEANS 15, LA.

An Affiliate of STOCKHAM VALVES & FITTINGS, Birmingham, Ala.



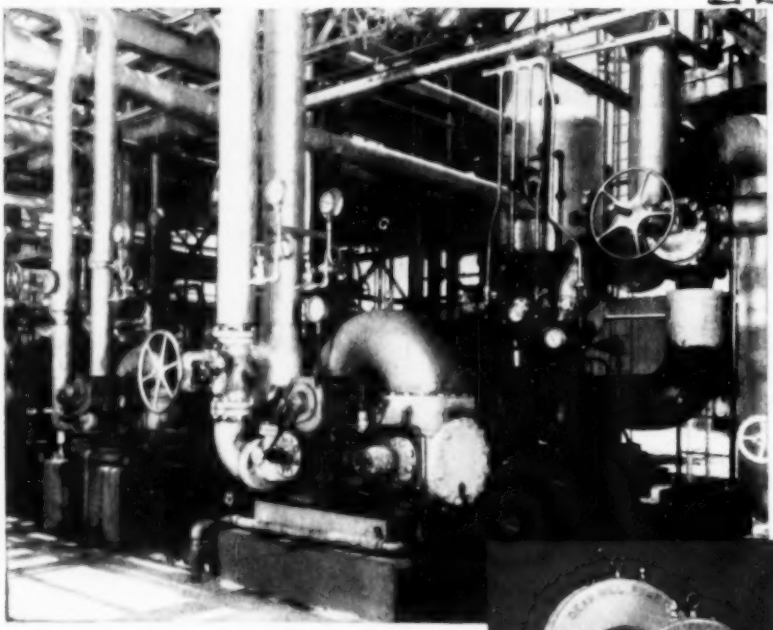
Wedgeplug Valves are available in three types. Wrench-operated, Handwheel-operated, and Worm Gear-operated. All sizes can be steam-jacketed.

WEDGEPLUG
General Service
STEEL VALVES

To obtain more data on advertised products see page 1840

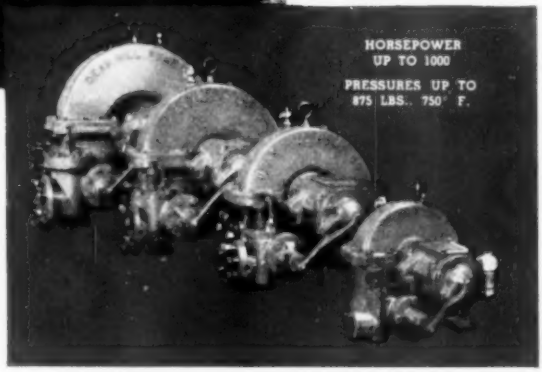
How to stretch a "Power Penny"

You'll never know how much power a penny will buy until you get Dean Hill Steam Turbines on the job. Their super rugged construction, their service-engineered design, their low maintenance, their remarkable power-producing ability all add up to more power per penny.



POWER AT WORK

Here are Dean Hill Type DH Steam Turbines at work driving centrifugal pumps at Bay Petroleum Corporation's Chalmette, La. refining operation.



DEAN HILL TURBINES are specifically designed for operation at medium steam pressures. Since they are the single stage, double impact type, low steam consumption is a tremendous economy feature. Steam rates are excellent under these conditions. Get full details and specifications. Write today.

DEAN HILL PUMP COMPANY

Pump and Turbine Engineers Since 1895

INDIANAPOLIS 7, INDIANA

Chicago • New York • San Francisco • Boston • Denver • Albuquerque • El Paso • Salt Lake City • New Orleans • Philadelphia • Tulsa • Los Angeles • Pittsburgh • Houston • Dallas
St. Paul • Toledo • Cleveland • Grand Rapids • Birmingham, Ala. • Louisville • Memphis • Nashville • Richmond • Bogota, Col. • Mexico City • Montreal • Reading, Pa. • The Hague, Neth.

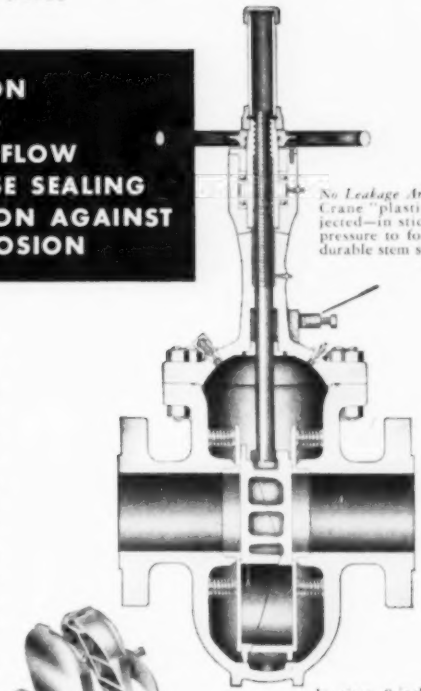
when it's a long time between turns...

you need

dependable CRANE pipe line valves

CLASS 600 GATES

they give you
- EASIER OPERATION
- TIGHTER SEATING
- SMOOTH, CLEAR FLOW
- COMPLETE GREASE SEALING
- BETTER PROTECTION AGAINST WEAR AND EROSION



No Leakage Around Stem with Crane "plasti-packing." Injected—in stick form—under pressure to form a tight and durable stem seal.

Infrequent operation—long exposure in toughest weather—can't affect the efficiency of Crane Pipe Line Gate Valves. All working parts are sealed in grease to assure smooth operation and positive closure of the dual-seating double disc. Spring-loaded plates retain grease in body during operation. There's no problem of erosion either, since disc is fully seated in open position as well as in closed position. Equally important, see how the conduit-type disc ports coincide with seat opening—note the absence of dirt-catching pockets. That means smooth flow with no turbulence, minimum pressure drop—and absolute minimum of internal wear from normal service.

Full-Way or Venturi patterns for working pressures up to 1440 pounds, oil or gas. Sizes 2 to 30-inch. Flanged or Butt-Welding ends. Full information contained in Circular AD-1864. Ask your Crane Representative, or write direct.

In sizes 8-inch and larger, a *new Spring Counterbalance Unit* keeps both sections of the wedge disc in alignment for quicker response—easier operation.

Spring-loaded plates retain grease in body while valve is being operated. In addition, they wipe foreign matter and excess grease from disc faces and help guide the disc.

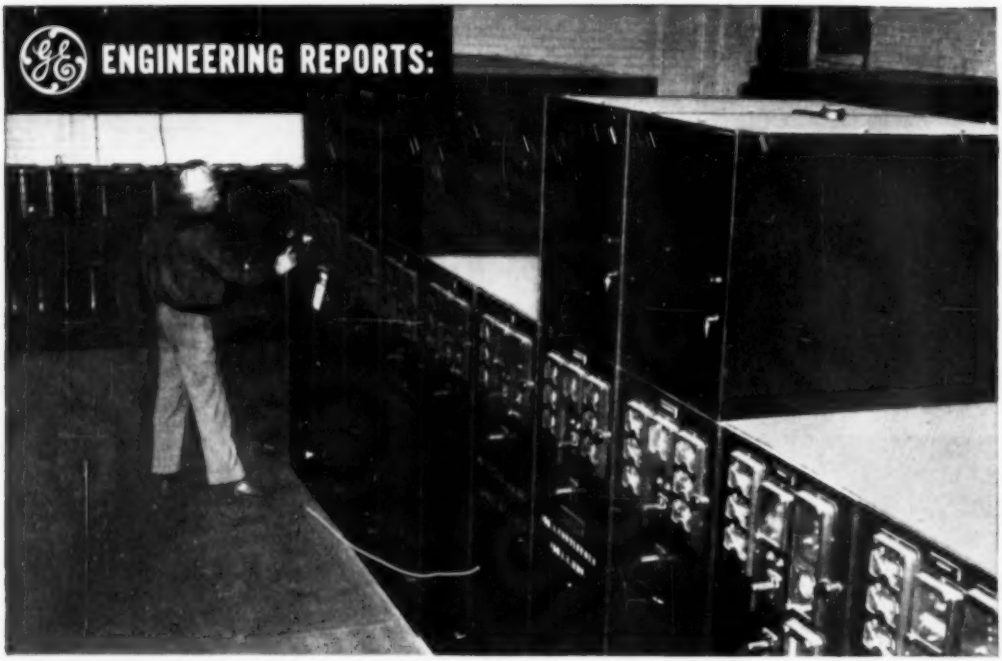
The Complete Crane Line Meets All Your Valve Needs. That's Why
More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

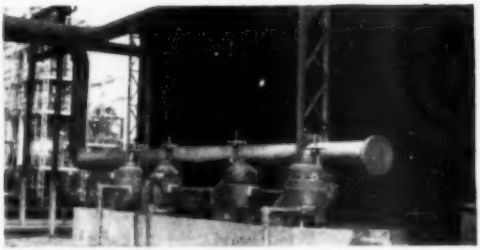
ENGINEERING REPORTS:



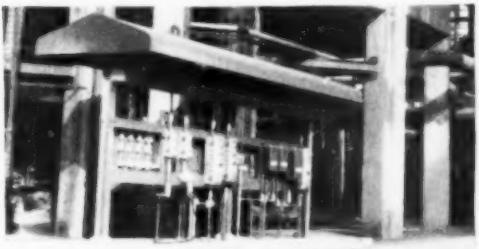
INCOMING POWER is controlled by this G-E metal-clad switchgear. Providing primary circuit protection, these compact G-E units are factory-assembled to speed installation, metal-enclosed to provide maximum safety to personnel.

Refinery's power system helps

PLANT POWER FACTOR is improved by 360 kvar G-E capacitor equipment near a refinery-type load-center substation.



COOLING-WATER PUMPS, in non-hazardous location, are driven by four G-E vertical motors rated 150 hp, 440 volts.



IN HAZARDOUS LOCATION near catalytic cracking tower, explosion-proof enclosures help protect G-E motor starters.

HIGH VOLTAGE POWER is brought economically to load centers and stepped down at unit substations like this one, rated 1000 kva.

Racked-up G-E explosion-proof equipment includes manually operated master breaker and magnetic starters for plant motors.

maintain high-output continuity

G-E ENGINEERING uses modern facilities in designing improved equipment to give you greater continuity of power service. These engineers at the new G-E Switchgear Development Laboratory examine films of a typical switchgear test.

G-E engineered distribution system helps keep Phillips Petroleum Co., Phillips, Texas plant refining 80,000 bbl/day

In its refinery at Phillips near Borger, Texas, the Phillips Petroleum Company cracks and blends petroleum products at the rate of 80,000 barrels per day. Helping to maintain this output on a continuous basis is the plant's power distribution and drive equipment, co-ordinated by Phillips' and General Electric engineers to meet the plant's specific processing needs.

Here is one more in a long list of petroleum refineries that have profited by G-E engineering experience. Whatever *your* refinery's electrical needs, General Electric application engineers can help you or your consultants co-ordinate your electric equipment for maximum efficiency. For more information, contact your nearest G-E Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 660-31

Engineered Electrical Systems for Petroleum Refineries

GENERAL ELECTRIC

ATTAPULGUS Fullers Earth
POROCEL Activated Bauxites

...two reliable names along the path of petroleum processing

WHAT DO YOU WANT TO PURIFY?

There's an Attapulgus or Porocel adsorbent to fit your process technique for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from process liquids or gases. Materials treated in principal applications are: motor oils and other lubricating, specialty, and technical oils; petrolatums and waxes; aviation and motor gasoline stocks; kerosene; diesel and heating oils.

DO YOU HAVE CATALYST OR CATALYST CARRIER NEEDS?

Attapulgus or Porocel sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.

WHAT DO YOU WANT TO DRY?

We offer a wide range of reliable, thoroughly proved desiccants for drying air, hydrogen, carbon dioxide, hydrocarbon liquids and gases.

SPECIAL GRADES?

Mine and plant facilities permit prompt and economical production of grades meeting individual customer specifications. Our laboratories and technical staffs welcome the opportunity of assisting in research, development, design and operating problems. Your inquiries are invited.

ATTAPULGUS CLAY COMPANY *Fullers Earth* • **POROCEL CORPORATION** *Activated Bauxites*

Dept. D, 210 West Washington Square, Philadelphia 5, Pa.

PETROLEUM CHEMICALS DIVISION
NEWS

December ★ One of a Series of Interest to the Petroleum Industry ★ 1952

DU PONT AUTOMOTIVE ENGINEER

James A. Hodges joined the Du Pont Petroleum Chemicals Division as an automotive specialist in 1950. Since then he has been attached to the West Coast district office.

He brought to Du Pont an extensive background in automotive engineering and service. Early in his career he was a supervising mechanic for the U. S. Forest Service. He then joined the Chevrolet Division of General Motors

JAMES A. HODGES

as an inspector and field engineer.

During World War II, Hodges spent two years with the U. S. Army supervising the erection and operation of automotive repair shops. He was also an instructor at the Army Officers' School on the maintenance and overhaul of Chevrolet equipment. After the war he rejoined Chevrolet as a field engineer and fleet service manager. In this capacity he conducted clinics on fleet service problems and field tested experimental units.

Super-instrumented Cadillac New "Flagship" of Du Pont Fuel Test Fleet

Sleek, futuristic *experimental* cars are constantly whetting the public appetite for more speed, power and economy. But to produce this desired performance, gasoline quality is equally as important as improved engine design. Du Pont's new, super-instrumented Cadillac is actually an experimental car—specially equipped with Du Pont-designed instrumentation to help refiners study the problems of meeting the power plant demands of tomorrow's cars.

This newest addition to the Du Pont Petroleum Chemicals Division's fuel test cars—a big Series "75" Cadillac limousine—might well be called the "Flagship" of the fleet. Carrying more than 1,000 pounds of sensitive research equipment, it is the most complete fuel test car on the road today.

In spite of its size, there is little room to spare in the car. Even the well-known Cadillac fishtails on the rear fenders have been used. One conceals an exhaust fan. The other, an automatic CO₂ fire extinguisher. And two thirds of the front seat has been cut away. The space is occupied by a multitude of electronic dials and instruments.

AIR-CONDITIONED

This unique "laboratory-on-wheels" is even completely air-conditioned. Besides adding to the comfort of passengers, the air conditioning means that the windows can be kept closed to screen out traffic noises.

DEMONSTRATES FUEL ECONOMY

The car made its first public appearance at the 1952 Automotive Industries show in Philadelphia. There it attracted wide interest from the general public as well as from automotive and petroleum people. Its intricate instrumentation proved to be a real drawing card with the public. And the crowd expressed considerable interest in one particular dial—the "miles-per-gallon-of-gasoline" indicator.

If an observer wants to know how many miles per gallon a gasoline is delivering at any given time, he merely pushes a button on the rear instrument panel and reads the figure on one of the dials. The instrument computes it automatically—by electronically dividing the car speed by the rate of fuel consumption.

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

Even a Boy can fight Communism with Truth

Kids on Radio Free Europe Send Hope To Pals Behind Iron Curtain

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At least $4,000,000 is needed this year to support and expand the operations of Radio Free Europe and Radio Free Asia. In addition, the Crusade for Freedom is seeking the signatures of Americans, on Freedom-Grams. These will be your personal pledges of hope for a free world.

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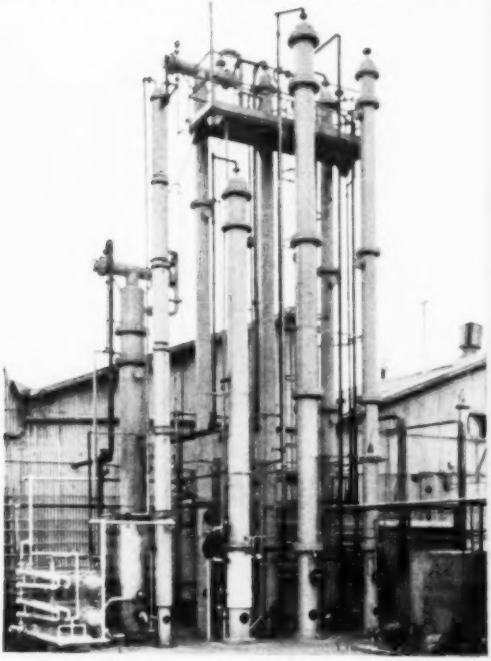
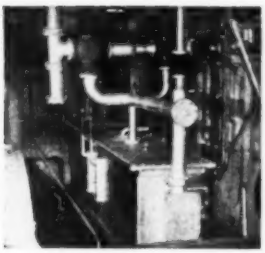


Wulff Process Recovery and Purification section. In operation over 19 months, the plant has sold acetylene commercially for the past 10 months.



This fully automatic cracking furnace is the heart of the Wulff Process. In the past 10 months of commercial operation, this unit has required no maintenance—capacities and yields have remained the same.

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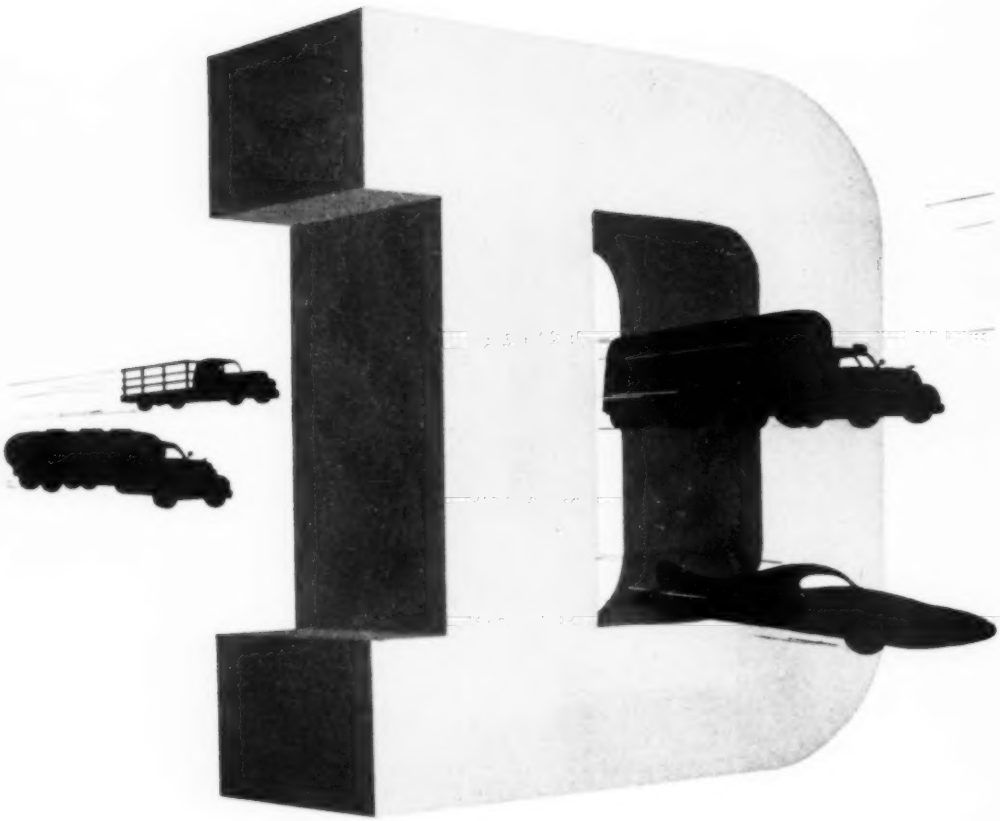

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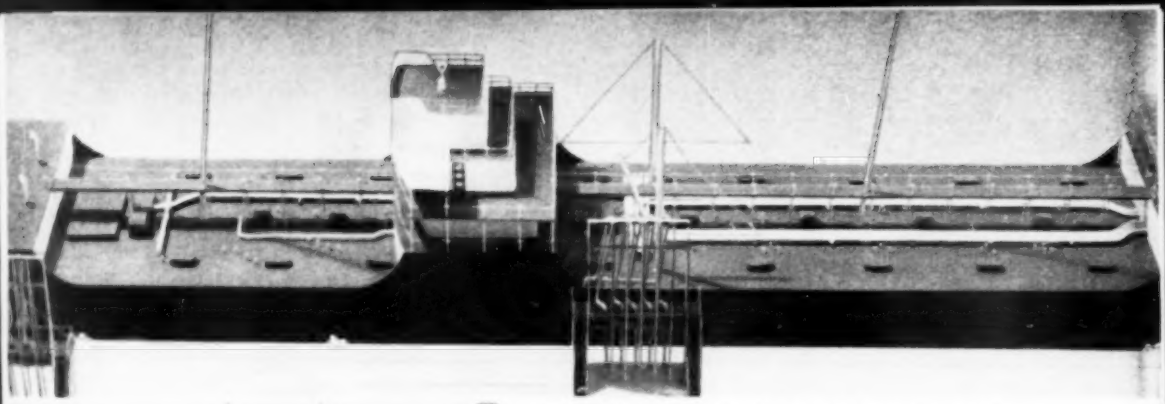

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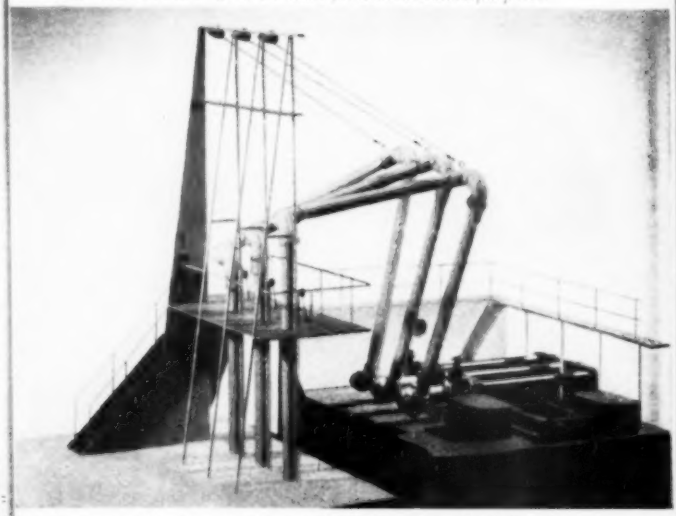

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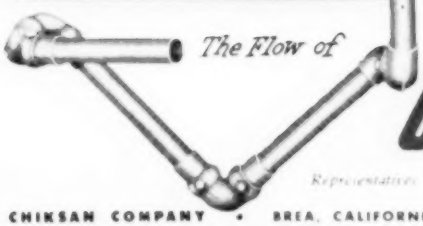

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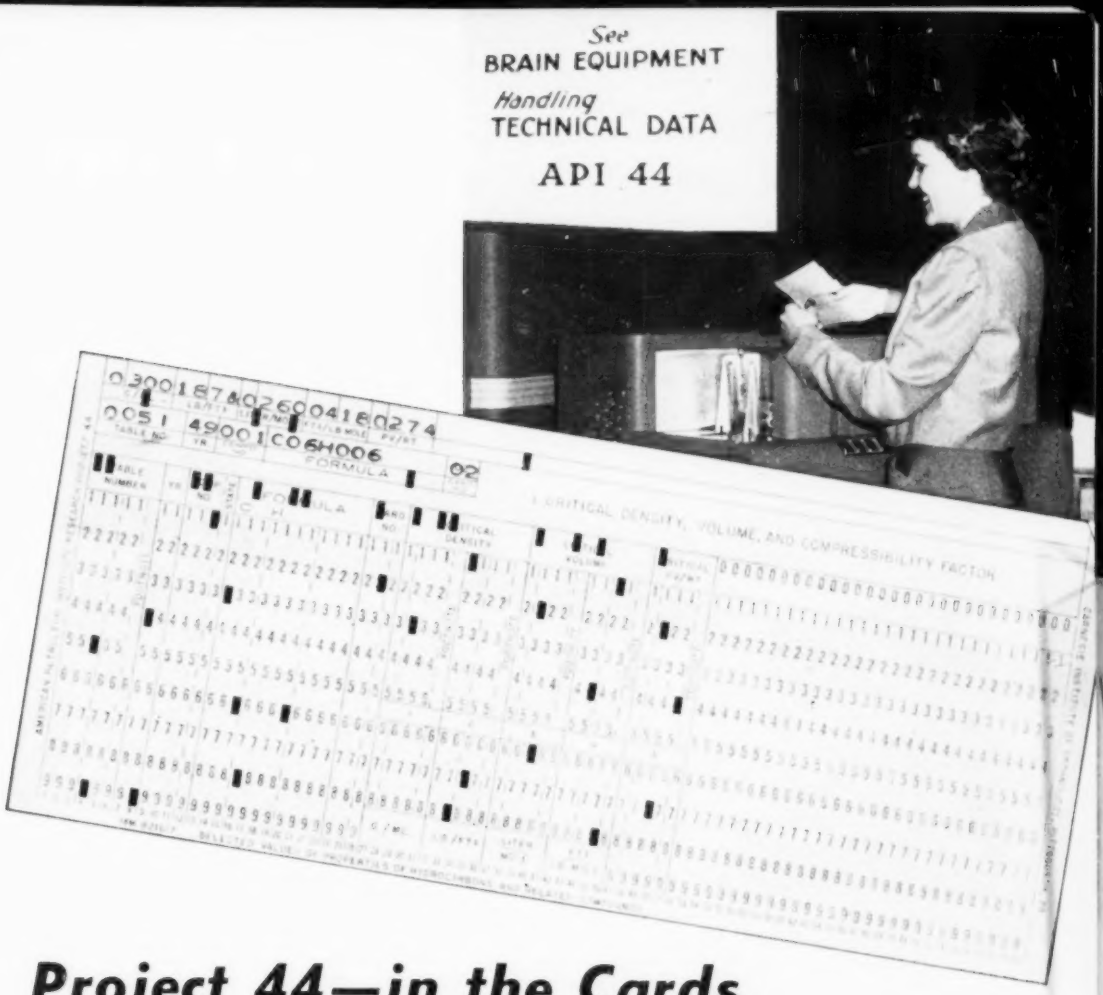


Project 44—in the Cards

IBM technique save time, reduces errors in handling fundamental hydrocarbon data

By V. B. GUTHRIE, Editor

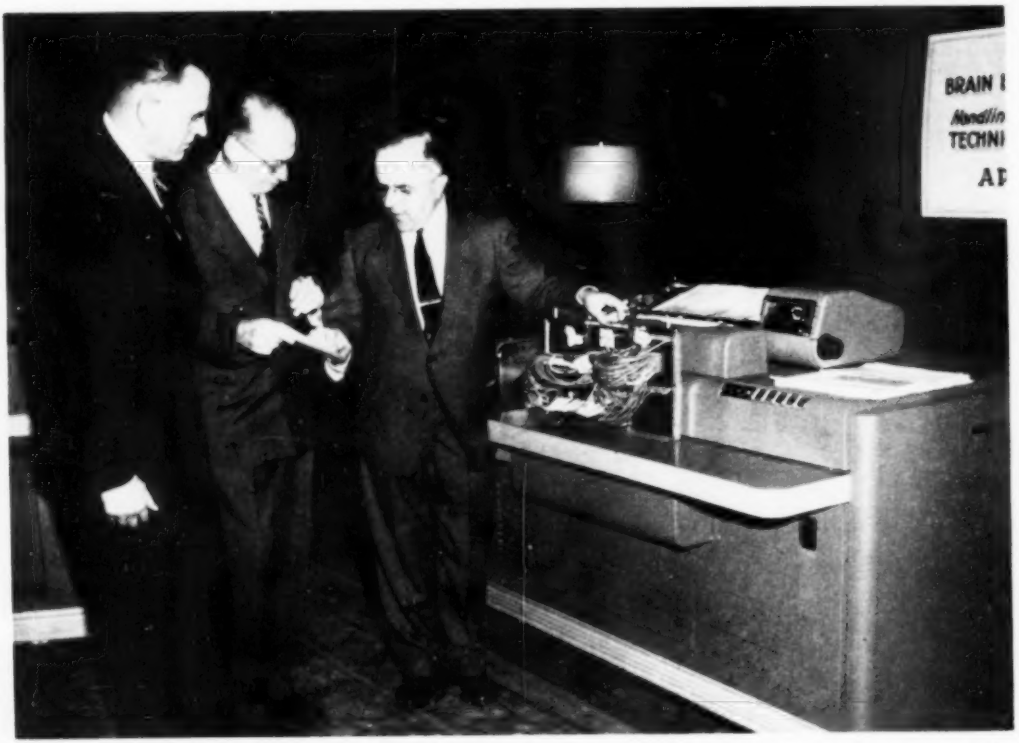
THE large amount of data on the physical and thermodynamic properties of hydrocarbons and related compounds, developed in 10 years' work in API Research Project 44, has been set up for use on automatic punched-card machines. The machines are of the type now found in many oil company accounting offices, and include electronic calculators.

A total of 36,500 punched cards carry over 100,000 entries on more than 1000 different compounds. This data has heretofore been available only on loose-leaf sheets and in bound volumes.

The punched-card technique makes possible the marshalling of the data in this API research project, for selecting, arranging and listing the various compounds, by any order of their properties, in about ONE FIFTIETH of the time it can be done in hand operations. By use of the automatic calculating machine, the further step or working out involved problems based on the research data can be done in minutes as against hours by head and hand effort.

The "API 44 Mechanical Brain" was demonstrated at the Institute meeting in Chicago, Nov. 10-14, as a feature of the session on Fundamental Research. The punched cards on which the data have been assembled, and the automatic machines, are those of the International Business Machine Corp. The display was in charge of Dr. Jack Sherman, mathematician, of the Beacon, N. Y. research laboratory of The Texas Co., where considerable work has already been done with the punched-card machines.

The demonstration attracted much attention and brought out informal discussion as to the applications of the punched-card technique in



DR. JACK SHERMAN (right) demonstrates how any desired data on a group of hydrocarbons can be tabulated in minutes with the IBM accounting machine. This equipment was shown in action at the recent annual API meeting in Chicago, where this picture was taken.

design engineering work of the oil companies and refinery construction firms, in research, and in crude and product analysis for control purposes at the operating plants, among other uses.

Save Time and Reduce Errors

Where technical data can be put on punched cards for use in automatic machines, a general advantage is the saving of the time of technologists from assembling data from company records and published sources and then tabulating it. Where calculations are involved, the professional workers can be released from lengthy hours of hand calculations. To this extent, more efficient use can be made of the time of available technologists in these days of shortages of engineers and chemists.

Another advantage of the use of the punched cards is that errors are virtually eliminated, once the task is properly set up. The factor of human error increases where the tabulation or calculation is involved and several people may be working on it.

Still another advantage of the use of the punched-card machine is where the element of time is a factor in arriving at test results, as in making up refinery balances for plant control purposes. With manual calculations, balances are made up only once a month in some refineries because of the amount of work involved. When the results of the analyses of crude and products are known and the required data and calculations taken from the tests, considerable time has already elapsed before any required changes in processing unit operating conditions can be made. Where punched cards can be used, this type of work can be greatly speeded up.

Already in Wide Use

Punched-card machines are already widely used in oil company accounting and auditing operations, including the figuring of royalty payments and other special tasks. The production branches of some oil companies are using them in computing corrected oil volumes from tank gages and in computing gas volumes from orifice meter chart data.

Some refining companies have found such a large volume of technical work adaptable to these machines that they have set up separate installations for this purpose only. For example, reduction of mass spectrometer data and recalibration of these instruments have been greatly accelerated by the use of electronic calculators. Extensive numerical work connected with the design of distillation equipment has likewise been greatly expedited.

The punched-card technique was used at the Beacon laboratory of The Texas Co. in an important part of the work in the international standardization of oil measurement tables, a joint project of the American Society for Testing Materials in this country, and the Institute of Petroleum in England. Some 300,000 punched cards were used in preparing, from the original data of the U. S. Bureau of Standards, various tables in American and British systems of units pertaining to gravity reduction, volume reduction and interrelation of units. It has been estimated that the punched-card machine method, which accomplished the work

in 6 months, saved 15 man-years of hand computations.

100,000 Separate Entries

The API Project 44 data, as set up on punched cards, comprises more than 100,000 separate entries on such properties as boiling points, melting points, specific gravities, indices of refraction, viscosities and thermal data such as heat of formation, heat capacity, entropy, etc. The compounds listed include all types of hydrocarbons and some sulfur compounds.

The 36,500 IBM cards contain the data in arrangements similar to those on the printed sheets. The main difference is that the names of the compounds have been coded by assigning consecutive numbers within each group of compounds. The codes and full names of the compounds are punched in a separate set of "name" cards, which can be used in conjunction with the data cards for any desired listing. The cards are in distinctive colors for easy visual identification.

Equipment That's Needed

Certain items of equipment are necessary for the use of punched cards. All of the equipment for the Project 44 cards is rented from International Business Machine Corp. Some of this equipment of IBM, or of other manufacturers, as has been stated, is now in general use in oil company bookkeeping or accounting departments. The first prerequisite for the use of punched cards is a "tub" file, or some type of file case where the cards can be kept in the order of the properties of the compounds.

The next step in their use is the sorter, where the cards can be automatically grouped in numerical or alphabetical sequence according to any classification punched on them. The Project 44 cards are arranged in the order of the properties of the compounds. The sorter provides a fast automatic machine process for arranging the cards for the preparation of reports or calculations. From the sorter, the cards go to a collator which selects the cards according to the information desired, together with the name cards of the compounds, in an arrangement for tabulating the data. The cards are then automatically run through an accounting machine, where the desired data is printed, with the name of the compounds to which it applies, at the rate of 100 lines a minute.

As an example of this sort of work done by the mechanical brain, it might be desired to list all the hydrocarbons which boil within 5 degrees of toluene. The procedure of the operator would be to take from the file all the cards having to do with boiling point. The sorter would be set to pull out all those cards showing a boiling point within 5 degrees of that of toluene. The collator would then put these cards and the name cards together for printing. The tabulator would print on one line of paper the name of the individual compound and its boiling point. After the operator has looked up the boiling point of toluene and set the sorter for the required range of this property, the entire machine operation is done in less than 5 minutes.

Where computations are involved, the automatic calculating machine is set up for the specific problem, the punched cards first having supplied the data required. This step calls for a more experienced operator than in the selecting and tabulating work. Regardless of the form in which the problem arises, its solution can contain only the basic arithmetical operations of addition, subtraction, multiplication and division. It is thus necessary to arrange the problem in the proper sequence of these four basic operations which the calculating machine can perform. The machine then automatically works out the problem and punches the answers in the cards. The cards then go to the accounting machine, where the answer is printed out.

Machines Rent for $1200 Mo.

The set of machines demonstrated at Chicago, including the sorter, collator, accounting machine and calculator, rents for $1200 a month. It is estimated the machines, on this type of work, would replace 50 men working at desks on manual computations.

Examples of the type of work which can be done by machines of the type demonstrated at Chicago, with the punched cards with API 44 data, include:

1—Arranging compounds in the order of increasing or decreasing boiling points, or according to hydrocarbon type, or in the order of increasing number of carbon atoms, etc.

2—Listing compounds according to selected ranges of data, for example, those boiling between any two temperatures, i.e. 350° and 400° F.

3—Making more elaborate selections of data, such as compounds which boil between any two temperatures and which also have some other properties, such as melting points within a specific interval, or refractive-index values within a range.

4—Listing compounds according to increasing density values, or those which have density values within any given interval.

5—Arranging compounds of any type according to index-of-refraction values at either 20° or 25° C.

Cards Cost $360 a Set

In the case of Project 44, the complete data collected on the physical and thermodynamic properties of hydrocarbons and related compounds has already been made available on punched cards for use in IBM machines. The full set of 36,500 cards can be purchased for $360, plus shipping costs, on application to Dr. Frederick D. Rossini, Carnegie Institute of Technology, Pittsburgh, who is director of Project 44.

In general practice, the conversion of source material to punch cards is performed manually on a card punch machine. Reading from a table or other source of the data, the operator presses keys similar to those of a typewriter. The machine converts the information to the form of holes punched in the card.

With the Project 44 data available on punched cards and with an IBM sorter, collator and tabulator at hand, some examples of information based on the properties of hydrocarbons which could be arrived at in a very few minutes, were given in a paper presented at the session on Fundamental Research of the API Chicago meeting.* These included:

"1. An investigator wishes to have all the hydrocarbons of the paraffin, cyclopentane, cyclohexane and benzene series normally boiling up to 180° C., arranged in a list according to ascending normal boiling points. The IBM equipment will produce such a list already typed. The investigator will thus have in his hands a list of all the possible main components of a straight-run gasoline arranged according to boiling point.

"2. An investigator wishes to have a list of all possible hydrocarbons (listed in the tables) which normally boil in the range 120 to 130° C. Such a list would be provided quickly in typed form.

"3. An investigator wishes to have a list of all the hydrocarbons (listed in the tables) arranged according to the values of refractive index, n_D, at 25° C., or the values of density of the liquid at 25° C. Such a list could be provided quickly.

"4. An investigator wishes to have all the hydrocarbons (listed in the tables) arranged according to thermodynamic stability with respect to the elements carbon (solid, graphite) and hydrogen (gas) as given by the values of the standard free energy of formation ΔF^f, for 25° C. (298.16° K.). Such a list could be provided quickly. Similar lists could also be produced quickly for each of the other temperatures for which values are tabulated, as 400° K., 500° K., 600° K., 700° K., 800° K., 900° K., 1,000° K., etc."

*"A Decade of Progress in Selecting Data on Hydrocarbons and Related Compounds", by Wayne E. Kuhn, The Texas Co., New York, and Frederick D. Rossini, Carnegie Institute of Technology, Pittsburgh; presented by Dr. Kuhn before the Session on Fundamental Research, 22nd Annual Meeting of the American Petroleum Institute, Chicago, Nov. 10, 1952.

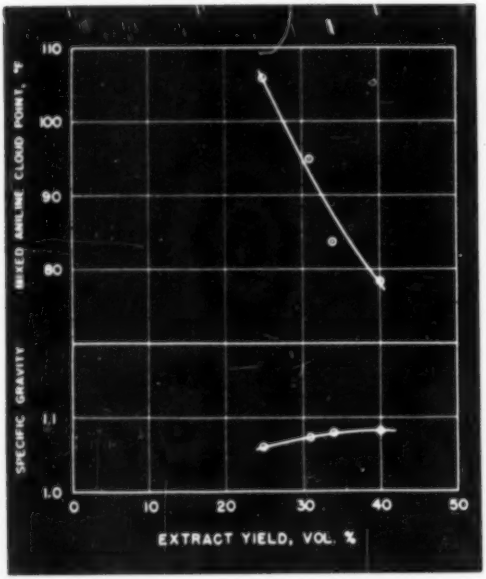


FIG. 1 Relation between properties and volume of extract obtained in treating a heavy gas oil with furfural

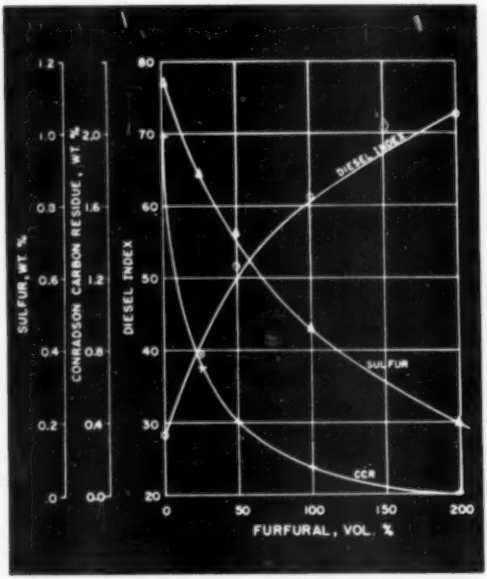


FIG. 2 Physical properties of raffinates from furfural extractions

Better Yields from Cat Cracking

Conversion of highly aromatic stocks like heavy gas oil can be improved by furfural refining

By CHARLES W. SHELLEY and C. W. RACKLEY
Magnolia Petroleum Co., Beaumont, Texas

THE characteristics of the charge stock is of primary importance in catalytic cracking. The type of molecular structure and the boiling range of the stock determine the susceptibility to cracking and the nature of the cracked products. At commercial cracking conditions and one pass operation, a gasoline yield of 42% may be obtained on a furfural refined Mid-continent gas oil as compared to 3% on the aromatic extract from the same gas oil.

The marginal profit of catalytic cracking and the inflated cost of processing equipment demands strict attention to the process. Past practice has been to crack stocks that are not marketable, rather than to screen them carefully. Future economy may warrant the use of refining processes for the preparation of catalytic charge stocks. Several patents exist describing methods of improving the cracking yields of crude oil fractions[2, 7]. Most of these are processes similar to those used for solvent refining of lubricating oils such as propane deasphalting, solvent extraction with liquid sulfur dioxide, furfural, etc. A few commercial installations [1, 4, 5] are currently in operation using some of the above processes for catalytic charge stock preparation. However, very little data have been published showing the effect of the refining process in relation to actual catalytic cracking yields from the treated stock.

Experimental Work

The present study was made in the process control laboratories of Magnolia Petroleum Co.'s Beaumont refinery. The entire investigation was conducted on small scale treating and cracking equipment and exemplifies the type of laboratory investigations made possible by the utilization of bench scale cracking equipment described previously[6].

A catalytic heavy gas oil originating from Midcontinent crude oil was chosen for this investigation because of its poor cracking characteristics. It has a high aromatic content making it of particular interest for a furfural extraction study. The physical properties of this gas oil are shown in Table 1.

The furfural extraction was conducted in a continuous 3-stage pilot unit. Preliminary studies indicated that water-saturated furfural at relatively low temperatures exhibited extraction properties desirable for this type of refining. The extraction was performed at 100°F., which is near the estimated low temperature

Table 1—Properties of Catalytic Heavy Gas Oil

Gravity, API	18.2
ACP, °F.	154.6
Bromine No.	26.7
Arol. Heat, °F.	40
ASTM Pour, °F.	80
Ramsbottom C, Res.	1.40
KVS @ 100°F.	93.3
KVS @ 210°F.	37.9
Sulfur, Wt. %	1.14
Distillation, °F.	Atmospheric*
IBP	539
10	610
50	707
90	786
EP	857
Rec. %	98

* Calculated from 10 mm. Hg. Vacuum Distillation

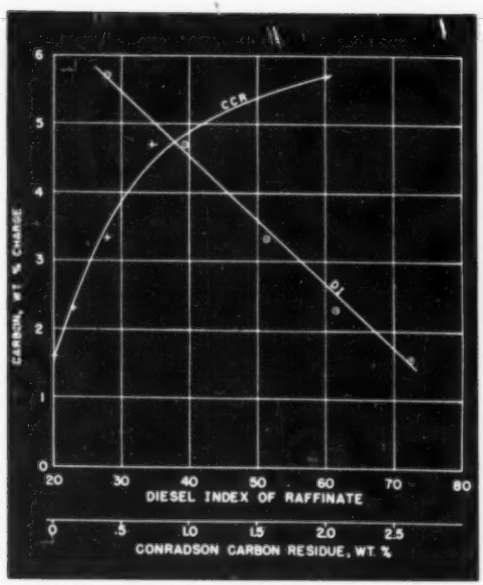


FIG. 3—Relation of carbon deposits on cracking catalyst to physical properties of cracking charge stock

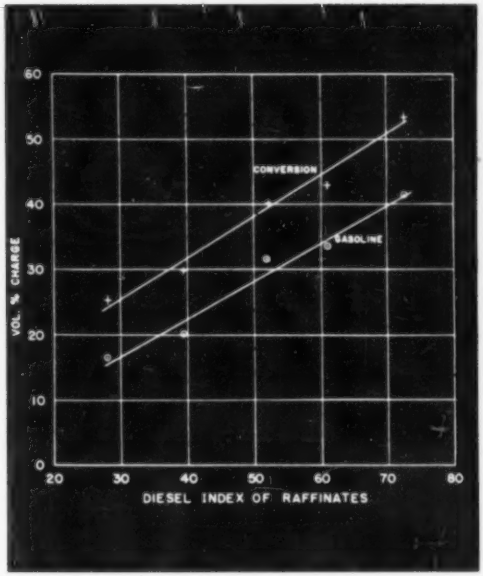


FIG. 4—Relation between Diesel Index of cracking charge, the yield of gasoline, and total conversion

for commercial operation without requiring refrigeration. This temperature was also close to the pour point of the heavy gas oil. The severity of the treat was varied by using solvent percentages from 25 to 200 based on charge stock.

The catalytic cracking yields presented in this paper were obtained from runs made on a small scale fixed bed cracking unit employing granular catalyst. The cracking conditions for all runs were as follows:

Catalyst Type	Clay
Catalyst Activity Index	50
Average reactor temperature, °F	950
Space velocity, Vol. Hr. Vol.	1.5
Catalyst to oil ratio, Wt./Wt.	1.5

Results of Solvent Refining

The yields of raffinate obtained from furfural treating the gas oil with various quantities of solvent are as follows:

[illegible]

Specific gravity of extracts increased and the mixed aniline point decreased with the increase of the severity of furfural treats which is contrary to the usual experiences with lubricating oil refining. This is illustrated by the data presented in Fig. 1.

The physical properties of the raffinate were changed correspondingly. The increasing concentration of paraffins indicated by the increasing Diesel Index of the oil is shown in Fig. 2. Diesel Index is calculated by the following formula:

[illegible]

The carbon residue and sulfur content of the raffinate were reduced to negligible quantities only after severe treating, as noted in Fig. 2. These data indicate that the carbon residue and sulfur bearing components are as difficult to extract as some of the hydrocarbons of aromatic type.

Effect on Cracking Yields

The yield of catalytic gasoline from furfural raffinates was very high. Based on the original heavy gas oil charged to the furfural unit, the yield of gasoline from catalytic cracking only the furfural raffinate fraction was considerably higher than that obtained from cracking the total heavy gas oil. A comparison of the products from 1000 bbls. of catalytic heavy gas oil before and after furfural refining is given in Table 2.

Carbon Formation

The carbon formation is of primary importance for the following reasons:

1. Carbon burning capacity is the major expense in the design and operation of catalytic cracking equipment and frequently restricts the oil charging rate on commercial units.

2. Carbon concentrations on the catalyst restricts conversion by reducing the effectiveness of the catalyst.

3. Increase in carbon deposits lowers the total volume of recoverable liquid and gaseous products.

Solvent refining greatly reduced the carbon formation on cracking. Yields of carbon in relation to the yields of raffinate are shown in Table 3.

The relationship between carbon formation and the Diesel Index of

Table 2—Production from 1000 bbl. Catalytic Heavy Gas Oil before and after Furfural Refining

Charge to cracking	1000 bbl. untreated	600 bbl.* Furfural raffinate
Dry gas, 1000 lbs.	12.8	10.7
Total butane, bbls.	25	50
C-free gasoline, bbls.	168	293
No. 2 Fuel oil, bbls.	197	78
Catalytic heavy gas oil, bbls.	551	266
Carbon, lbs.	3.1	3.8
Extract, bbls.	0	400

* 200% Furfural treat at 100° F.

Table 3—Cracking Characteristics of Furfural-Treated Stocks

Raffinate yield, Vol.-%	100	75	60	66	60
Carbon, wt.-% of cracking charge	3.1	4.7	3.3	3.3	3.8
Gasoline yield, Vol.-% of charge to cracking	16.8	20.1	21.7	21.6	15.2
Furfural Volume % charge	0	25	50	100	200
Total butanes, Vol.-%	2.5	3.6	6.3	7.5	12.4
Dry gas, Wt.-%	2.6	3.6	5.6	6.1	6.6
Gasoline, end point, temperature, °F	375	395	415	415	375
No. 2 Fuel oil, F. B. P., °F	675	675	675	675	675
Heavy gas oil, Yield-%	55.4	47.9	39.0	38.9	34.7

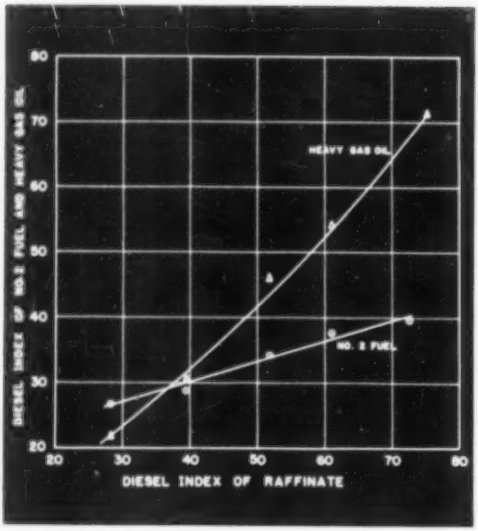


FIG. 5 Relation between Diesel Indexes of the refined stock and gas oils produced on cracking

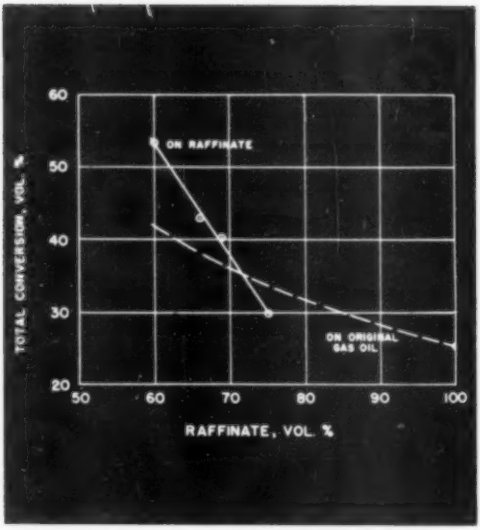


FIG. 6 Relation of total conversion in catalytic cracking to severity of furfural treats

the cracking charge is shown in Fig. 4. It will be noted that the carbon decreased in proportion to the increase of the D. I. of the charge stock fraction.

Oden and Granberry[5] report that the Conradson carbon residue of a catalytic charge stock is totally converted to carbon. The relationships between the CCR of the charge stocks and carbon formations of this investigation is also shown in Fig. 3.

Gasoline and Gas Yields

Catalytic cracking the raffinates gave greatly increased gasoline yields as shown in Table 3 also.

The increase in paraffinicity of the charge stock is reflected in the improvement of gasoline yields. This is illustrated in Fig. 4 showing the relationship between the Diesel Index of the charge stock and the C_4-free gasoline yield (410°F. E.P.). The octane number, Research Method with 3cc. TEL gal. added, was improved from 91 on the original gas oil to 98 on the 200% treated raffinate.

The total butane yields increased with treating in a similar manner to gasoline. Dry gas yield, propane and lighter, increased only slightly as shown in Table 3.

Gas Oils

The total gas oil yield diminished as the treating severity increased. The gas oil disappearance and the yield of light and heavy gas oils are shown in Table 3.

It was observed that with light solvent treating the Diesel Index of the heavy gas oil fraction, produced on cracking the raffinate, was higher than the Diesel Index of the No. 2 Fuel Oil fraction. With increased refining the Diesel Index of the heavy gas oil increased rapidly and was only slightly less than that of the charge. This is illustrated in Fig. 5 and indicates that the heavy gas oil would make excellent cycle stock. Samples of this cycle stock were cracked and the yields were found to approximate those obtained from a furfural refined gas oil of similar Diesel Index.

Total Conversion

Cracking severity was estimated on the basis of total conversion which refers to gas oil disappearance. On the basis of the original catalytic heavy gas oil, a larger volume was converted to various products after solvent refining than before, although the quantity of reactor charge was smaller. This is illustrated in Fig. 6 showing the conversion based on the raffinate and original gas oil volumes as related to the raffinate yield. The high conversion of solvent raffinates is attributed to the reduction of carbon lay-down on the catalyst which permits more effective cracking of the susceptible components. The relation between conversion and carbon yield is shown in Fig. 7. Viland[6] reported similar results from cracking with catalysts of different residual carbon contents. He also observed small changes in product distribution.

The effect of the physical properties of the cracking charge oil on conversion are illustrated in Fig. 4. This shows conversion to be proportional to the increase in the Diesel Index of the charge oil. The distribution of the products also changed with the Diesel Index. To illustrate this change in product distribution, the product yield as a percentage of conversion is used. The purpose of this correlation is to show the difference in molecular breakdown between the easily cracked components of the whole catalytic heavy gas oil and of the choice fractions. The yields as a percentage of conversion are related to the Diesel Index of the charge oil are shown in Fig. 8. The advantage of increasing the Diesel Index of a highly aromatic stock by solvent refining are reflected in increased gasoline and butane percentages and decreased carbon and dry gas percentages.

Cracking of Aromatic Extract

Since the presence of the aromatic type compounds appeared to have a detrimental effect on yield and product distribution from cracking the original gas oil, these observations were verified by catalytic cracking the extract phase from the 100% furfural treat at the same conditions as those employed for the raffinates. The yields are as shown below:

Carbon, wt.-%	12.0
Gasoline, Vol.-%	3.0
Total gas, wt.-%	4.7
No. 2 Fuel oil, Vol.-%	8.4
Hvy Gas oil, Vol.-%	69.0

These data confirm previous indications that the aromatic type components which are removed by furfural extraction, produce predominantly coke and gas and only neglible quantities of gasoline.

Cracking of Paraffins

Since the solvent refining indicated that increases in the Diesel Index of this catalytic heavy gas oil gave

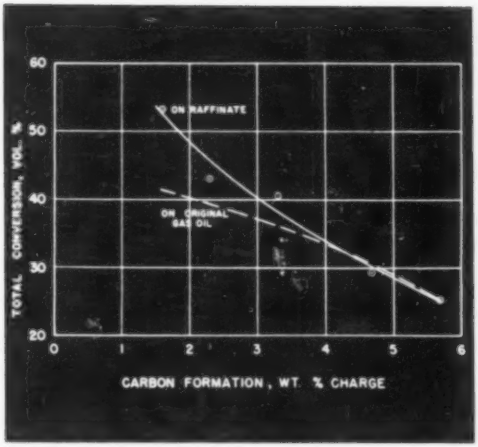


FIG. 7—Above: relation between carbon formation and total conversion

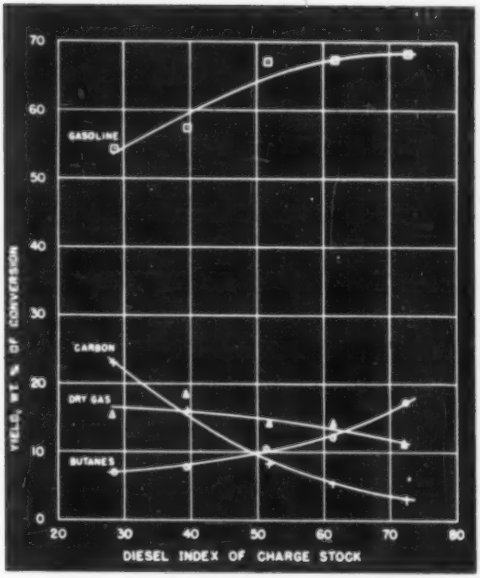


FIG. 8—Right: relation between Diesel Index of charge oil and yield distribution

more desirable yields, further study was made to determine if paraffins as are found in paraffin wax give the most desirable product distribution. The raffinate from a 100% furfural treated catalytic gas oil similar to that used in the initial study, was dewaxed with benzol-acetone. A wax yield of 11% of the raffinate was removed. Each of these fractions was cracked separately. The yields are shown below:

	Cracking Charge	
	Paraff. Wax	Wax free raff.
Carbon, wt.-%	1.6	1.7
Dry gas, wt.-%	10.5	7.8
Tot. butanes, vol.-%	18.2	9.6
Gasoline, vol.-%	59.5	45.
No. 2 Fuel oil, vol.-%	7.4	20.7
Hvy. gas oil, vol.-%	33.2	24.6
Conversion	59.4	54.7

These data indicate that the wax produced less gasoline but a larger total volume of cracked products than the wax-free fraction. The wax formed very little carbon and the yield of No. 2 Fuel Oil was low.

Conclusions

Catalytic cracking yields from highly aromatic stocks such as catalytic heavy gas oil can be improved by solvent refining with furfural.

The aromatic type components contained in stocks of this nature are resistant to catalytic cracking and yield principally coke and gas and negligible quantities of gasoline.

The paraffin wax components have low resistance to cracking and produce good gasoline and very high butane yields. The oil fraction obtained after removing wax and aromatics is slightly more refractory to catalytic cracking, but yields more gasoline and less butanes than the paraffin wax.

Acknowledgement

The writers would like to express their appreciation to Messrs. J. W. Newton, W. W. Leach and P. L. Smith for permission to publish this material, and to Mr. V. A. Kalichevsky for his inspiration and helpful suggestions.

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Meet the Authors

Mr. Shelley

Mr. Rackley

Charles W. Shelley has been with Magnolia Petroleum Co. for over 16 years. Most of that time has been spent at the refinery at Beaumont, working on catalytic processes, and when this article was written he was a process engineer in the technical department. Since then he has been made a training assistant in the industrial relations department. He attended Texas A. & M.

C. W. Rackley, co-author, is also at Magnolia's Beaumont refinery and is a process engineer in the technical department. He is a native of Georgia, and started with Magnolia in 1949 after receiving a degree in chemical engineering from Georgia Tech. During World War II he served three years in the Air Force as a bomber pilot.

How to Save those Critical Alloys

Eleven recommendations to PAD on conserving needed metals by API Interim Advisory group

AS AN AID in the conservation of critical alloys, 11 specific recommendations applying to the allocation of steels for use in refineries have been made to the Petroleum Administration for Defense by the American Petroleum Institute's Interim Advisory Committee on Alloy Steels.

The recommendations are a part of a report released last month by the 30-man committee, composed of representatives from both the refiners and their suppliers. The group was appointed in May, 1951, by API President Frank M. Porter when it became apparent that a thorough study by experienced personnel was needed to determine the maximum extent to which conservation of critically scarce alloys could be effected without jeopardizing the oil industry's vital productive capacity. Group made a preliminary report at the 1951 API meeting.*

In its entirety, the report is concerned principally with the conservation of nickel and molybdenum in ferritic alloy steels used in refineries for both high and low temperature service. The recommendations apply largely to these alloys used primarily in pipe, tubing, cast and forged valves, fittings, and accessory equipment.

In addition, austenitic and other nickel alloys are necessary in refining where straight chromium steels are impractical because of high temperatures, corrosion by naphthenic or other organic acids, and attack by some chemicals, such as phenol, phosphoric acid, etc., used in treating or catalytically. Subsequent reports are planned by the Committee making recommendations with respect to alloys for petrochemical requirements and special processing materials.

The 11 recommendations made in the current report are:

1—No alloy steels containing molybdenum should be approved for service below a metal temperature of 775° F., except for bolts and except when a chromium-molybdenum steel is required for resistance to corrosion.

2—Carbon-molybdenum steels may be used for service at metal temperatures above 775° F. when required for strength at temperature. Chromium-molybdenum steels may be used at metal temperatures above 775° F. when required for resistance to corrosion, for resistance to graphitization and/or strength at temperature.

3—All refinery bolting should be suitable for high temperature service, and AISI 4140 steel should be approved for such bolting. (Note: All orders for AISI 4140 steel bolting should specify, "for high temperature service.")

4—The molybdenum content of 0.5% molybdenum steels should not be less than 0.40%.

5—Austenitic stainless chromium-nickel steels should be approved for replacement of similar steels in installations wherever in service and so equipped.

6—Alloy steels for tubular products and forgings (valves, fittings, flanges, other pressure-containing parts) should be restricted to the grades indicated in Table 1 in blackface type only.

7—Alloy steels for castings (valves, fittings, flanges, and other pressure-containing parts) should be restricted to the grades given in Table 2.

8—Alloy steels should be approved for temperatures below —20° F. to meet applicable ASME, API-ASME, or ASA Code requirements.

9—Ferrous and nonferrous alloys in general usage under normal conditions should be approved for trim for valves, fittings, and other similar applications. This includes austenitic stainless steels, Monel, Hastelloy, Stellite, and other such alloys.

10—Alloy steel welding rods in common usage for welding the alloy steels herein recommended should be approved.

11—Recommendations on furnace castings, excluding pressure-containing parts, should be in accordance with NPA Order M-80, Schedule C, part II.

Restrictions on the use of alloy steels beyond those covered by these recommendations would result in a serious reduction in the oil industry's capacity and thereby retard the national defense program, the Committee emphasized in its report. It was further pointed out that the recommendations will not involve any decrease in the existing efficiency of refinery operations.

Significant molybdenum conservation is anticipated through reductions of 0.05% and 0.10% in the moly contents of all grades of steels having nominal moly contents of 0.5 and 1.0%, respectively. This does not entail any reduction in allowable stresses for these steels. In the light of present knowledge, the Committee believes that a further reduction below 0.4% would necessitate a lowering of the allowable stresses. Net result would be a greater actual use of molybdenum because heavier sections would be required.

Further conservation of molybdenum can be effected by restricting the use of carbon-moly steel to temperatures above 775° F.

Still more savings can be attained through a decrease in the number of grades of allowable chrome-moly steels. This number was reduced to five and two of these containing 1% moly were recommended for approval only for the comparatively few cases where unusual severe service conditions exist.

There are no safe substitute steels for the AISI chrome-moly 4140 steel used for bolts or for the standard nickel steels for very low temperatures, the Committee believes. Continued approval of these steels for such applications will not require significant amounts of molybdenum and nickel.

The report went into considerable detail on the historical background of alloy steel development for the refining industry, discussing the extensive experimental work carried on by refiners and tube manufacturers in the

Table 1—Commonly Used Ferritic Grades of Alloy Steel for Refinery Pipe and Tubing*

AISI Grade	Nominal Percent Chromium	Molybdenum
T-M		0.50
[illegible]	1.00	0.50
T1,	1.25	0.50
[illegible]	1.25	0.75
[illegible]	2.00	0.50
T2,	2.25	1.00
[illegible]	2.00	1.00
T5	5.00	0.50
T7	7.00	0.50
T9	9.00	1.00

[illegible] grades shown here have been in common use for temperatures above about 300° F. Those shown in blackface type the grades covered in the API Interim Advisory Committee recommendations.

Note: Under the recommendations, T2's may still be permitted only when justified by unusual severity of operating conditions. T5 steel should be restricted to severely corrosive service. The molybdenum content of T5 and T9 steels should not be less than 0.40% for both the T5's and T9 grades.

Table 2—Recommended Grades of Alloy Steels for Castings

A-T-M Symbol	Range % Chromium	Molybdenum
[illegible]	[illegible]	[illegible]
[illegible]	1.00-1.50	0.40-0.65
[illegible]	2.00-2.75	0.90-1.20
[illegible]	4.00-6.50	0.40-0.65
[illegible]	8.00-10.00	0.90-1.20

Note: Both these steels should be permitted only when justified by unusual severity of operating conditions.

Only steel should be restricted to severely corrosive service. The molybdenum content of both these steels should not be less than 0.40% for both the T5 and T9 grades.

early 20's, for example. This program was necessitated by the increasing process temperatures being encountered as petroleum processing technology advanced.

Prior to World War II there were about 37 different alloy steels used to some extent in pipe and tubing manufacture for refinery service. This number was reduced to the 10 ferritic grades now in common use for applications at temperatures above about 550° F. These 10 are also shown in Table 1, and include, of course, the five covered in the recommendations and indicated by the blackface type.

Forgings, castings, and pressure vessels of alloy steels were also summarized historically in the Interim Committee's report.

The term "forgings" covered forged and rolled steel flanges, welding necks, welding nozzles, forged valves, welding fittings including ells, tees, reducers, caps, etc., and screwed and socket type fittings. The weight used in a refinery project is a relatively small percentage when compared to the total weight of pressure vessels and piping.

Use of critical alloys in forgings had been maintained at a minimum by refiners even before the current emergency, the report explained, through concentration on the following comparatively few grades:

I. For applications above 750° F.:

1—carbon-0.5% molybdenum.

2—0.5% chromium-0.5% molybdenum.

3—1% chromium - 0.5% molybdenum.

4—1.25% chromium - 0.5% molybdenum.

5—2.25% chromium - 1% molybdenum.

II. For conditions of temperature, oxidation, and corrosion.

1—5% chromium - 0.5% molybdenum.

2—7% chromium - 0.5% molybdenum.

3—9% chromium-1% molybdenum.

4—Type 304, 18% chromium - 8% nickel.

5—Type 347, 18% chromium - 8% nickel + columbium.

6—Type 321, 18% chromium - 8% nickel + titanium.

7—Type 316, 18% chromium - 8% nickel + molybdenum.

Carbon steel has been standard practice for temperatures below 750° F. The historical development in the case of castings has been similar in general to that of forgings.

For pressure vessels, heat exchanger shells, and similar pressure-containing equipment, the Committee reported carbon steel unless corrosive conditions dictate the need for more resistant materials. The alloy steels most commonly used in that case are:

1—carbon-0.5% molybdenum.

2—0.5% chromium - 0.5% molybdenum.

3—1% chromium - 0.5% molybdenum.

4—1.25% chromium - 0.5% molybdenum.

5—2.25% chromium-1% molybdenum.

6—5% chromium - 0.5% molybdenum.

Where temperature, oxidation, chemical attack, or combinations of these conditions occur, metals and alloys which have been used as liners, or occasionally as solid-walled vessels are: Type 405 or 410, 11 to 13% chromium; Types 304, 347, 321, and 316; and Hastelloy B, Monel, and nickel.

Tracing the history of alloy use in pressure vessels, the Committee report pointed out that petroleum processing at temperatures of 550° F. and upwards, especially with sour crudes, led to corrosion at exorbitant rates.

About 1925, the industry specified the use of stainless steel for liners for pressure vessels because of its corrosion and oxidation resistance. This chromium-nickel alloy proved to be more than adequate for most applications and, to combat high materials cost, linings of 16 to 18% chromium steel were used. These alloys are of the age-hardening type and, because of cracking difficulties encountered, materials with more suitable characteristics were sought.

It was found that the 11 to 13% chromium steels, such as Type 405 with ¼% aluminum and the Type 410 low carbon alloys, provided suitable corrosion resistance for many conditions. The 4 to 6% chromium material used in solid alloy parts was unsuitable for linings because of its air-hardening characteristics and the dilutions resulting from the welding of the alloy to the carbon steel.

Thus, for the bulk of pressure vessels used in refining, critical alloy materials have been held to a minimum by using thin corrosion-resistant liners in thicknesses generally less than ⅛ in., which is a small percentage of the vessel wall thickness.

Because corrosion was encountered in both sides of the internals, it was necessary to fabricate them of solid plate material. In many applications, 4 to 6 chromium-½ moly material was sufficient. However, under severe conditions, higher alloys were necessary and internals fabricated from relatively light weight 11 to 13 chromium alloy sheet were developed and are finding use.

Continued evidence developed with the advent of catalytic cracking processes and later with catalytic reforming processes, operating at elevated temperatures (and pressures in the case of reforming), proved out the continuing need for alloys. It was brought out in particular, for example, in the case of cracking that graphitization has recently shown the need for going from the previously used carbon steels to steels containing additions of chromium and molybdenum.

The Interim Advisory Committee on Alloy Steels

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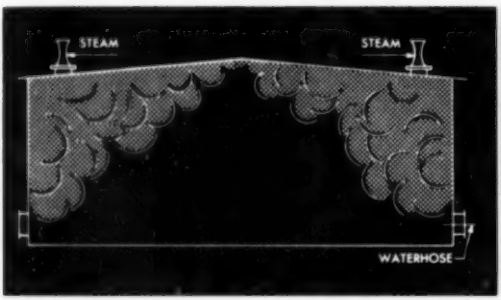
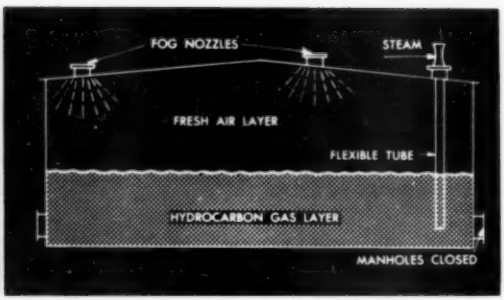
F. S. G. Williams, Taylor Forge & Pipe Works.

LIGHTWEIGHT FLEXIBLE TUBE reaches down into tank, pulls vapors up from the bottom as shown in drawings below



THE OLD—gas leaves at top, air enters at bottom; too much turbulence and diffusion



THE NEW—gas leaves from bottom, air enters at top; uniform separation, clean and efficient gas removal

How to Gas-Free Storage Tanks

Hydrocarbon vapors are heavier than air, so Shell pulls them up from the bottom instead of off the top

AN IMPROVED method for gas-freeing and cleaning atmospheric storage tanks has been developed at Shell Oil Co.'s Norco, La., refinery. Based on the fact that hydrocarbon gases generally found in such tanks are heavier than air, the method pulls them out from the bottom through a flexible tube suspended into the tank rather than trying to remove them directly through the top openings.

The previous conventional technique is shown at the left in the drawings above; the new system is at the right. As can be seen, turbulence and diffusion of the air and gas is held to a minimum. The gases pass out of the tank in a relatively uniform layer with fresh, clean air following above it.

Shell's past practice of gas-freeing tanks required two or three days before the tank was gas-free, depending upon the service it had been in. It consisted of the following operations: 1) disconnect and blind all piping to the tank, 2) open the roof manholes and connect three small steam eductors, 3) steam the tank from four to eight hrs., 4) open the shell manholes and wash-out openings and water-wash the bottom as the tank continues being gas-freed.

Thus, during at least the major part of the 2-3 day period, men were working in what could be classified as a hazardous location. It is felt that the reason such a long time is required to gas free the tank was: any puddles of light oil on the bottom were gradually vaporized and, since fresh air and steam were being pulled from the bottom of the tank through the tank up to the roof manholes, a continuous turbulence of a gas mixture was being drawn through the entire tank. Thus, it required a long ventilating period to diffuse and dilute this air-gas mixture to the allowable concentration.

The new method uses only a single eductor. Bottom manholes are kept closed. Moist fresh air enters at the top through the remaining open manholes. (See drawing at right, above.) The tubing is a flexible cylinder com-

prising steel spirals clothed in a rubber fabric. It is 16 in. in diameter by 25 ft. long. Trade-named "Spiratube," it is very light and easy to handle, only weighing about 45 lbs. A single, flanged adapter, three ft. long, was attached to one end of the tube. This gives it an over-all length of 28 ft. and allows it to rest on the manhole flange. To prevent movement of the tube once it is in the tank, a weight is attached to its lower end after the tube is placed.

A home-made eductor, shown in the photographs and indicated in the drawing, was used on Shell's first test run and gave very satisfactory results. However, an eductor capable of moving some 300,000 cu. ft. hr. of air has been purchased recently and will be used on all future tank cleaning operations.

The fog nozzles placed at the other roof openings keep the fresh air entering the tank thoroughly moistened. This was done to eliminate the possibility of any trouble that might be caused by iron sulfide scale; and was later confirmed by an inspection of the shell, roof, and structural members of the tank.

The complete new procedure as used at Norco is as follows:

1—Haul all necessary equipment for a cleaning job to the site prior to removing the tank from service.

When possible, flexible hose should be used for water, steam, and air connections in order to minimize the high labor costs needed to run temporary piping. It usually takes about three days to complete this temporary piping job, and the cost is approximately 75% of the total preparation cost. A ball valve pump in good condition should be used in all cases for bottoms removal.

2—Pump out all possible products through existing lines.

3—Introduce water to float the remaining product, and pump product out.

4—With the exception of the drain and the foamite pipe, blind all piping to the tank. Wash out all other piping connected to the tank, after which all shell nozzles should be blinded.

5—As the case may be, open two or three roof openings, such as manholes, vents or flame arrestors. Insert one fog nozzle attachment in each opening. Open the water to the nozzles.

6—Lower the flexible tube attachment through a roof manhole and connect the eductor to the manway flange.

7—Start the eductor by gradually opening the steam valve. The opening of the valve to the wide open position should be spread over a five-minute period.

8—Continue ventilating the tank until the gas tests less than 50% of the lower explosive limit after which the shell manholes can be opened and the tank bottom washed. High pressure water should be used to remove thoroughly and break up scale sludge, etc. Washing can be done with a 150-psi. water stream.

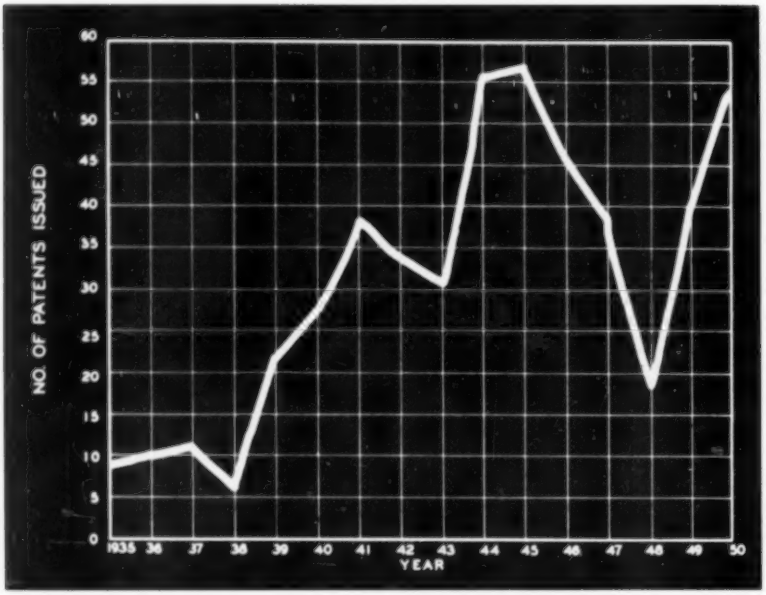
On two occasions recently it was found that scale and light sludge or muck could be washed easily with a 100-gpm. stream of water at 200 psi. The plant fire engine was used for a short period on those tests. Based on that, possibilities of using a water booster pump mounted on a trailer equipped with hose racks, nozzles, and the like for tank cleaning and other purposes is being investigated.

9—Shut off the fog nozzles and continue ventilating throughout the remainder of the cleaning and repairing period.

This article is based on information furnished PETROLEUM PROCESSING by Shell Oil Co. and contained in a report, "Improvements in Tank Painting and Cleaning Practices" by H. A. Le Blanc of the Norco refinery.

FLANGED ADAPTER facilitates suspension of the tube

LOWER AWAY! Tube being inserted through manhole. Home-made steam eductor is at right



PATENT TRENDS in use of phosphorus or phosphorus compounds in lubricants — totals by years

Phosphorus in the Lubricants Field

Chemistry of phosphorous-bearing additives, emphasizing recently more widely accepted types

By C. V. SMALHEER and T. W. MASTIN
Lubrizol Corp., Cleveland, Ohio

THE term "lubricant" is one which in the broadest sense applies to any material employed to reduce friction between relatively moving metal surfaces such as are involved in the operation of internal combustion engines, turbo-jet engines, turbines, gears of all types, and metal-working machines.

This article however, is concerned primarily with lubricant developments relating to the reciprocating internal combustion engine and its use to provide motive power, through appropriate transmission devices, for vehicles of all types. The role of phosphorus and its compounds in this area of the lubricant field is indeed an important one.

The first use of chemical compounds to improve the physical properties and performance characteristics of mineral oil base lubricants dates back to about the middle of the nineteenth century when Raecz[1] and Little[2] proposed admixing petroleum oils and soaps of fatty acids to produce greases.

With the advent of the automobile about the turn of the century, lubrication problems arose which were not met satisfactorily by uncompounded mineral oils, or oils and solid fats of vegetable and marine origin. The need for heavy-bodied oils and greases which would not become rancid and corrosive toward metal surfaces was met by the use of mineral oils which had been thickened or gelled with metal soaps of fatty acids in the manner disclosed by Raecz and Little.

Succeeding years have seen the growing use of a wide variety of chemical "additives" to improve the lubricants, especially crankcase and gear lubricants, required by internal combustion engine driven vehicles. Contributing to this ever-expanding use of additives have been the continuing advances in engine and gear design which have placed increasingly severe demands on lubricants, demands which are not satisfied by mineral base oils alone.

It is of interest that phosphorus, which was destined to occupy a position of importance in the lubricant additive field, was one of the earliest materials suggested to enhance the chemical stability of mineral oils. In 1917, A. L. Brown[3] proposed that mineral oils be mixed with 0.1-0.2% of red phosphorus to inhibit their oxidation. About the same time, the Westinghouse Co. secured a patent[4] which claimed that coating the walls of tanks with red phosphorus would prevent deterioration of mineral oils stored in them.

Somewhat earlier, Melamid and Grotzinger[5] disclosed that the inorganic acids of phosphorus, especially phosphoric acid, were useful in a manner akin to sulfuric acid for the refining of mineral oils. Here, however, no phosphorus remained in their refined product as distinct from the "additive" use of red phosphorus by Brown.

After the pioneer discovery by Brown in 1917, phosphorus and its compounds as additives for mineral oils received little attention until the mid-thirties.

The intervening years saw the introduction of the "germ" process lu-

bricants of Southcombe and Wells[6], in which mineral oils were blended with small proportions of high molecular weight fatty acids to improve their oiliness. Numerous patents also appeared which claimed benefits for the use of carboxylate esters, amines, phenolic compounds, and lead soaps in mineral oil base lubricants.

The re-entry of phosphorus into the lubricant field about 1935 was heralded by the appearance of a number of patents[7] dealing with the use of organic esters—both neutral and acid-esters—of phosphoric acid as anti-wear and extreme-pressure additives.

These were the first phosphorus compounds to assume commercial importance in the lubricant industry and were quite widely marketed in the United States under various brand-names during the period 1935-1940 for the production of automotive and truck crankcase and gear lubricants. Some typical compounds used were triphenyl and tritolyl phosphates, oleyl lauryl phosphate, and a mixture of mono- and di-lauryl phosphates.

The same period saw the first use of organic esters of phosphorous acid, i.e. phosphites, as oxidation and corrosion inhibitors in motor oils, a development whose beginnings can be studied in the early patents on this subject[8].

Esters of phosphoric and phosphorous acids—the first types of phosphorus compounds to find commercial application in the lubricant field—have remained important additive materials. Their most recent use, on an experimental basis, is in connection with the improvement of aircraft hydraulic oils.

The last decade saw great activity and progress in the lubricant additive field. It might be aptly stated that during this short span of years, the additive business passed from the stage of a promising industrial venture to that of a well-established industry possessing considerable resources and technical know-how. A wide variety of phosphorus compounds came under investigation and members of several new groups of phosphorus-bearing additives, notably phosphorus reagent treated organic materials of indeterminate composition and metal salts of dithiophosphoric acid diesters, found widespread commercial application. We shall discuss these more recent developments at length later on in this paper.

It has been said often that the number of patents appearing on a given subject is a fairly reliable index of the importance of that subject. By this yardstick, phosphorus compounds rank high in the lubricant industry. A survey shows that somewhat more than 500 patents having to do with the use of phosphorus compounds in lubricants issued in the period 1912-1950. Indicative of a vigorous growth is the fact that of this number, over 80% appeared during the last decade.

Table 1—Acid Strength of *O,O*-diesters

0.005(3) gram-equivalent of acid in 100 ml. of solvent composed of 50% benzene, 49.5% isopropanol and 0.5% water, by volume	Initial pH at 25° C.*
Acetic acid (99.5%)	5.1
O,O-di-(p-methylcyclohexyl) dithiothionophosphate	2.1
Sulfuric acid	0.6

* Precision Scientific Co. pH meter used.

The chart on the first page of this article shows the number of patents relating to phosphorus compounds in lubricants which appeared annually for the years 1935 to 1950, inclusive. The decrease in issued patents beginning in 1946 and reaching a minimum in 1948 can be attributed to the curtailed output of the U. S. Patent Office, rather than to a lessened interest in phosphorus-bearing additives. The Patent Office had accumulated an all-time high backlog of filed applications (153,-948) by December, 1948.

An analysis of the subject matter of the cited 500 or so pertinent patents reveals that about 75% of this number relate to the use of one or the other of the following two broad groups of phosphorus compounds in lubricants:

(1) Esters, ester-halides, and metallic salt-esters of inorganic phosphorus acids; and

(2) Organic phosphorus compounds of indeterminate composition whose preparation includes the use of at least one phosphorus-containing reagent.

The remaining 25% are divided among the following: purification of mineral oils through the use of phosphorus containing reagents, phosphorus or inorganic phosphorus compounds dispersed in mineral oils, organic compounds of known structure containing at least one carbon to phosphorus bond, naturally-occurring organic phosphorus compounds such as lecithin and cephalin, nitrogen-bearing organic phosphorus compounds of known structure, and a few miscellaneous organic phosphorus compounds not included in the previous groups.

No annual production statistics are available in published form on phosphorus-bearing additives by the lubricant additive industry. Some idea of the magnitude of this production can be gained, however, when it is considered that the total amount of inorganic phosphorus compounds used in the manufacture of lubricant additives in this country during 1950 was more than 5000 tons, containing more than about 1500 tons of elemental phosphorus. Substantially all of this phosphorus found its way into crankcase and gear lubricants.

Having reviewed in a general way the history and importance of phosphorus compounds in the lubricant industry, we shall now consider in greater detail what are perhaps the two most commercially significant groups of phosphorus-bearing additives to emerge during the past decade. These are: (a) metal salts of dithiophosphoric acid diesters having the general formula $(RO)_2PSSM$, where R is an organic radical and M is one equivalent of a metal, and (b) phosphorus - bearing organic compounds of indeterminate composition whose preparation includes the use of at least one phosphorus containing reagent. An indication of their importance in the industry is the fact that these two groups of additives have been the subject of more than 200 patents from 1940 to 1950, inclusive[9].

Whereas the compounds of group (a) form a closely related family, group (b) quite obviously includes materials of widely differing character. Insofar as possible we shall attempt to point out which materials in group (b) are of particular importance in the lubricant additive industry.

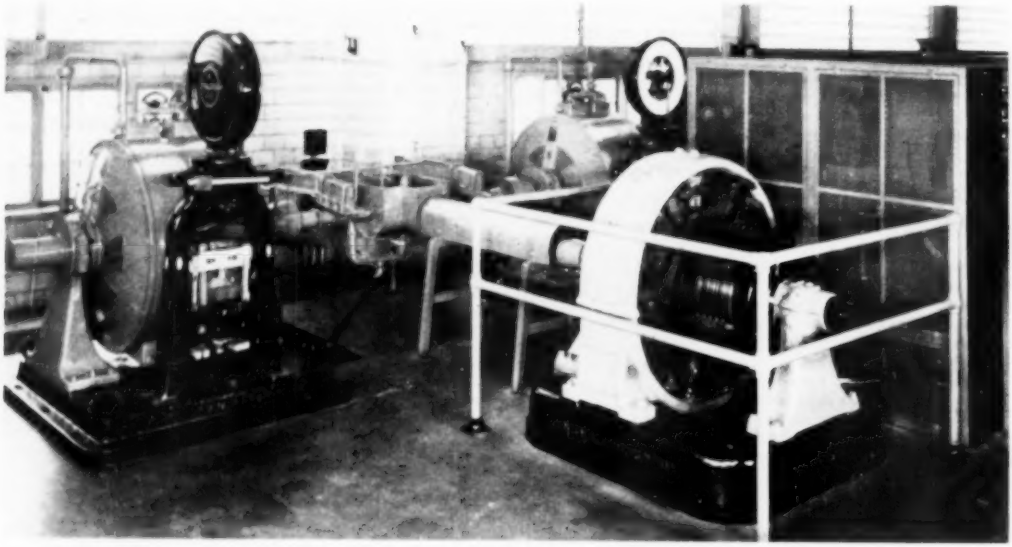
The reaction of organic hydroxy compounds—especially the aliphatic alcohols—with phosphorus pentasulfide to produce dithiophosphoric acid diesters was first described almost a century ago[10].

Only recently, however, has the structure been established for the acid diesters formed in this reaction:[11]

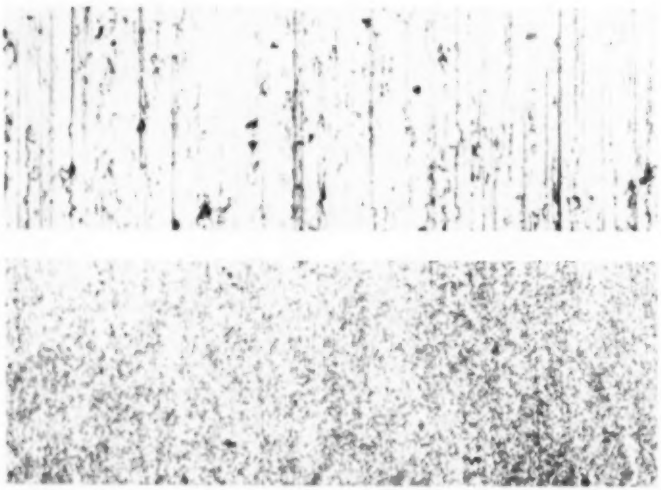
$$4ROH + P_2S_5 \rightarrow 2(RO)_2PS{-}SH + H_2S$$

These *O,O*-diesters are strong acids which form salts readily with metallic and organic bases. Their acid strength lies close to that of the mineral acids, as shown in Table 1.[12]

The metal salts of the higher molecular weight members are soluble in hydrocarbon oils. Employed in minor proportions in motor oils, they have been found to be remarkably effective in retarding corrosion of sensitive bearing metal alloys such as copper-lead, lead-bronze, etc. They appear to do this by building up a protective film on the bearing matrix which resists attack by the



FULL-SCALE REAR AXLE assembly in Lubrizol laboratories for testing additives at varying conditions



WEAR REDUCTION on cast iron piston surfaces by phosphatizing: upper panel untreated; lower panel treated

acids normally formed during engine operation.

In addition they reduce the rate of oxidation of lubricating oils. Certain salts, notably those of the alkaline earth group have detergent properties as well. The two metallic salts which have gained widest commercial acceptance in the industry are the zinc and barium salts.

The manufacture of dithiophosphoric acid salt-esters by the lubricant additive industry is still carried out in essentially the same manner described by Carius[16], i.e., reaction of phosphorus pentasulfide with an organic hydroxy body, followed by neutralization of the resulting acid-diesters with a suitable metal compound (usually a metallic oxide, hydroxide, sulfide, or carbonate).

A method of synthesis which more clearly discloses the exact structure of the product has been described by Martin et al[11], starting with the acid chloride intermediate.

The method is economically unattractive, however, and is not being used commercially.

In the lubricant additive field as in numerous other fields, a new and effective material is often discovered and pressed into service before much, if any, exact knowledge concerning its composition has been accumulated. Three classes of phosphorus bearing additive materials developed during the last decade fit in this category, namely:

(1) Reaction products of unsaturated organic compounds, especially non-benezenoid unsaturated hydrocarbons, with phosphorus sulfides; and derivatives thereof formed by reaction with one or more reagents such as water, alcohols, phenols, and metallic bases.

(2) Reaction products of high molecular weight carboxylate esters, especially ester-waxes, with phosphorus sulfides; and metal containing derivatives thereof formed by reaction with metallic bases.

(3) Reaction products of high molecular weight unsaturated carboxylate esters, especially unsaturated fatty acid glycerides, with a sulfur imparting

reagent (e.g., sulfur, sulfur chlorides, etc.) and a phosphorus sulfide.

Members of each of the above classes of materials are in use today as additives to improve the performance characteristics of crankcase or gear lubricants.

In keeping with our objective in this paper, we will say something about the chemistry and commercial utility of these "reaction product" materials.

During the latter part the nineteenth century, several workers[13] in the field of terpene chemistry reported that phosphorus pentasulfide reacted vigorously with various cyclic terpenes such as turpentine, p-menthadiene, and dipentene to form a resinous mass from which substantial quantities of p-cymene could be isolated by distillation. They were apparently interested only in the ability of phosphorus pentasulfide to convert cyclic terpenes to p-cymene and, therefore, neglected to study the initial reaction products obtained under milder conditions.

More recently a number of research laboratories in the petroleum and lubricant additive industries have undertaken studies of the reaction products which form when cyclic terpenes, as well as many other non-benzenoid, unsaturated hydrocarbons such as olefin polymers, are heated with phosphorus sulfides.

It was observed that unsaturated materials generally react in an exothermic fashion with phosphorus sulfides (especially phosphorus pentasulfide) to yield acidic, phosphorus-and-sulfur-bearing materials which vary in physical appearance from viscous oils to rosin-like solids, depending on the reaction conditions and the particular unsaturate and phosphorus sulfide employed. In the case of terpene hydrocarbons, the reaction usually proceeds with little or no evolution of hydrogen sulfide and experiments[14] indicate that in general two to three multiple bonds enter into reaction with one P_2S_5 fragment of a phosphorus sulfide.

Aside from the speculation (with respect to phosphorus pentasulfide derived products) that these materials are not homogeneous and possibly consist of both thiophosphate esters and thiophosphinic acids[15], nothing has yet appeared in the published literature concerning their composition. Judging from their viscous or amorphous solid states, one might also conclude that they may contain polymeric substances having recurring C-S-P and C-P-S units.

Unpublished work by Fay[16], dealing principally with the chemistry of the reaction between cyclohexene and phosphorus pentasulfide, reveals that under favorable conditions these compounds react to form substantial amounts of a crystalline dimeric anhydride,

$$C_6H_9-SP-SS-PS-C_6H_9$$

of Δ^2-cyclohexene dithiophosphonic acid.

Indirect evidence points to a substitution mechanism for the reaction involving a hydrogen atom in the alpha position from the olefinic bond; however, this was not demonstrated conclusively. Exploratory researches by Fay using other olefins — both aliphatic and cycloaliphatic types — indicate that each olefin possesses its own peculiar reaction characteristics toward phosphorus pentasulfide and that any attempt to extend the specific findings of his cyclohexene studies to other olefins would not be justified.

Unsaturated hydrocarbon — phosphorus sulfide reaction products, either as such or modified by further reaction with water, alcohols, or phenols, have proved highly effective in retarding bearing corrosion and reducing the oxidation rate of motor oils[17]. Certain metal bearing derivatives of these materials, prepared by reaction with metallic bases either in situ or as a later step, impart detergent properties to motor oils[18].

At least three major suppliers of lubricant additives are known to market one or more products of this general type.

The reaction of high molecular weight carboxylate esters such as lard oil, sperm oil, cetyl palmitate, wool grease, and the like with phosphorus sulfides gives rise to phosphorus and sulfur bearing organic materials of a more or less acidic character, depending on the particular reaction conditions and starting materials used. An increase in reaction temperature generally results in a lower acidity and a lower phosphorus content in the end-product, a substantial proportion of the phosphorus being lost in the form of a phosphorus oxide sludge (see Table 2).

Table 2—Wool Grease (four moles) Reacted with Phosphorus Pentasulfide (one mole) for Four Hours in Mineral Oil Solution[19]

Reaction Temperature	Phosphorus oxide sludge	Analysis of Product		
		% Sulfur	% Phos.	Acid No.
100° C.	none	5.68	2.09	70.6
140° C.	ca. 75 gms.	5.14	0.82	12.8

While it is difficult to follow the course of the many complex and perhaps competing reactions occurring in experiments such as those shown above, at least one of the major reactions—favored by high temperatures—involves a replacement of the carbonyl oxygen atom of the ester with a sulfur atom. Phosphorus sulfides have long been used in like manner to substitute a sulfur atom for the carbonyl oxygen atom found in ketones[20], acids[21] and amides[22].

Another reaction which may take place is that of the phosphorus sulfide with any carbon-to-carbon multiple bonds present in the ester, as discussed earlier.

Certain of these phosphorus sulfide treated esters will react with certain metallic bases to form salts which are soluble in hydrocarbon oils.

Both phosphorus sulfide treated esters and their metallic derivatives have found commercial application as additives to inhibit bearing corrosion and reduce the oxidation rate of motor oils[23]. The metallic derivatives, particularly those of the

Meet the Authors

Thomas W. Mastin, director of the Chemical Research Laboratories of Lubrizol Corp., Cleveland, has been associated with the company since 1942. He was born in New Castle, Indiana in 1913 and did his undergraduate work at Wabash College where he obtained an A.B. in 1938. He received his M.S. and Ph.D. from the University of Illinois in 1939 and 1942, and then joined Lubrizol as a research chemist.

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A member of the American Chemical Society and the Phi Society, Mr. Smalheer pursued graduate studies in organic chemistry at Case Institute of Technology from 1939 to 1942.

alkaline earth group exhibit some detergent properties as well.

It has long been known that high molecular weight unsaturated carboxylate esters such as lard oil, fish oils, olive oil, methyl oleate, and the like can be "sulfurized", i.e. combined chemically with sulfur, by merely heating with elemental sulfur or sulfur chlorides. The sulfur enters the molecule in a manner which is not clearly understood.

In this connection Farmer and Shipley[23] recently studied the reaction of sulfur with a few low molecular weight olefinic and cycloolefinic hydrocarbons such as isobutylene, cyclohexene, and 1-methylcyclohexene. They concluded that olefins in general give olefin sulfides, R-S$_x$-R', in which on the average half of the original unsaturation is lost and x has values up to as high as six. They found no evidence to support the formation of thioepoxide and dithiane, configurations which might be presumed to form on sulfur additon to ethylenic bonds.

When a sulfurized ester is heated with a small proportion of a phosphorus sulfide, particularly on such as phosphorus sesquisulfide which contains trivalent phosphorus, a complex phosphorus and sulfur bearing end-product results which may contain substantially all of the added phosphorus in oil-soluble form. Materials of this type impart extreme-pressure properties to mineral oils[25] and have been used in the preparation of commercial hypoid gear lubricants.

Tests on full-scale rear axle assemblies[26] demonstrate that whereas certain sulfurized ester materials are effective under conditions of low speed and high torque but not under conditions of high speed and relatively lower torque, certain of the sulfurized-phosphorized ester materials are effective in both types of service.

Our discussion thus far has dealt with the utility of organic phosphorus compounds in the lubricant field. It would be well to consider briefly a use for inorganic phosphorus compounds which is closely related to lubrication problems.

The treatment of metal surfaces with solutions of phosphoric acid or metallic acid phosphates to form protective coatings thereon has been the subject of a large number of patents since 1869[27]. Such protective coatings appear to consist chiefly of phosphates of the metal surface which has been treated. The familiar "bonderizing" treatment used extensively to make auto bodies rust-resistant is a good example of a "phosphatizing" process.

More recently it has been suggested that phosphatized surfaces possess a porous, oil-retentive structure well suited for such moving parts as pistons, piston rings, cylinder walls, valves, tappets and gears[28]. These surfaces are said to reduce wear, particularly during break-in periods, and have been used to some extent by the automotive industry for this purpose.

The preceding article was presented at a recent meeting of the American Chemical Society under the title: "The Role of Phosphorus and Its Compounds in the Lubricant Field."

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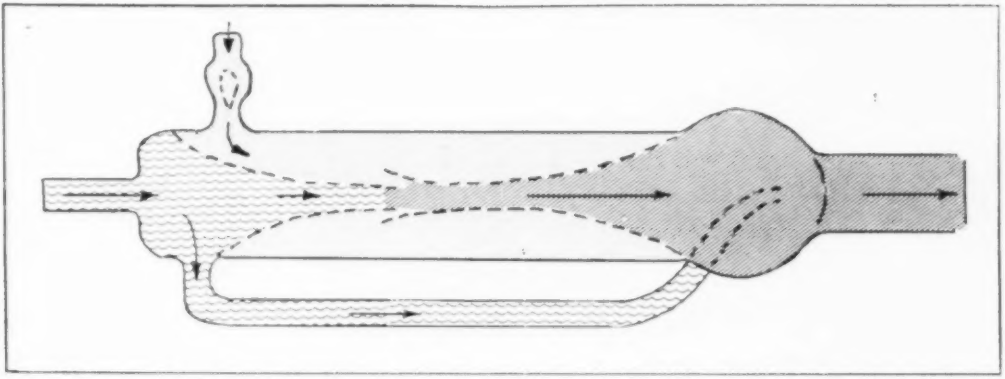


$10,500 ANNUAL SAVINGS are anticipated by using this combined mixer-aspirator

Better Pump—Cheaper Bromination

By **FRANK BREESE**
Pacific Coast Editor

TWO functional changes in the design of a small glass pump may cut General Petroleum's liquid bromine bill $10,500 a year.

The pump is an aspirator for injecting liquid bromine into cooling tower water to kill bacteria and algae. The changes have produced a more thorough mixture of bromine and water, resulting in a more effective "kill" concentration.

Cooling towers at GP's 125,000 b/d refinery at Torrance, Calif. have been equipped with 27 installations, operating and spares, for the regular bromine treatments. Bromine consumption will be reduced by about 50,000 lb. a year if the modified pumps continue as effective as they have been, GP engineers estimate. At the present price of 21c per lb., that's $10,500, the company said.

Before the new type aspirator was developed, inadequate mixing allowed more than 35% of the injected bromine to go to waste. The bromine was sucked into a glass tube through which the water flowed into the cooling tower, but because of its low water solubility, more than a third of the heavy liquid settled on the bottom of the suction pit or basin of the cooling tower.

To exterminate algae, GP refinery engineers have found it necessary to use a liquid bromine concentration of 4 to 6 ppm in the cooling tower basin. Although this concentration had been achieved all along, investigation showed that between 35% and 40% of the algae-killer was not being utilized. A bigger charge of bromine was required to reach the 4 to 6 ppm concentration in the mild blending process than would be needed if the bromine were efficiently dispersed.

Furthermore, a rapid build-up of the bromine concentration and consistent dissolution of it during the treatment would have the most devastating effect on algae, the engineers believed. However, the heavy properties of liquid bromine not only necessitated a large injection of it, but the casual blending retarded the build-up.

The problem was to agitate the mixture so an effective concentration could be produced quickly.

Employes Solved Problem

It was solved by Paul Dorin, cooling tower maintenance man, and Victor E. Thomson, glass-blower, who experimented with an idea until they came up with the new aspirator. (The simplified diagram illustrates the functional structure). Basically, there is a glass tube within a tube. Water from circulating pumps enters the tube under 15 to 18 psi. pressure and flows through the inner tube into the cooling tower system. Bromine is sucked into the water stream through a tributary tube.

The two new features are: (1) the mixing chamber and (2) the by-pass tube. The bulbular chamber provides more room for dissolving the bromine while the by-pass tube sends an additional spurt of water into the chamber. Rapid dissolution of the bromine is accomplished by supplying a greater amount of water to dissolve the bromine through the by-pass line and by obtaining a more intimate mixing of the bromine and water.

When the old aspirator was used, the injection rate was 90 lb. of bromine an hour. Injection rates as high as 300 pounds per hour have been reached with the new aspirator with water pressures of 16 psi. Control of injection rates is obtained with removable jets of varying size which are installed where the water enters the aspirator.

A 100% dissolution has been achieved, according to tests of the effluent from the pump injected into a 5-gal. bottle, eliminating completely the previous waste.

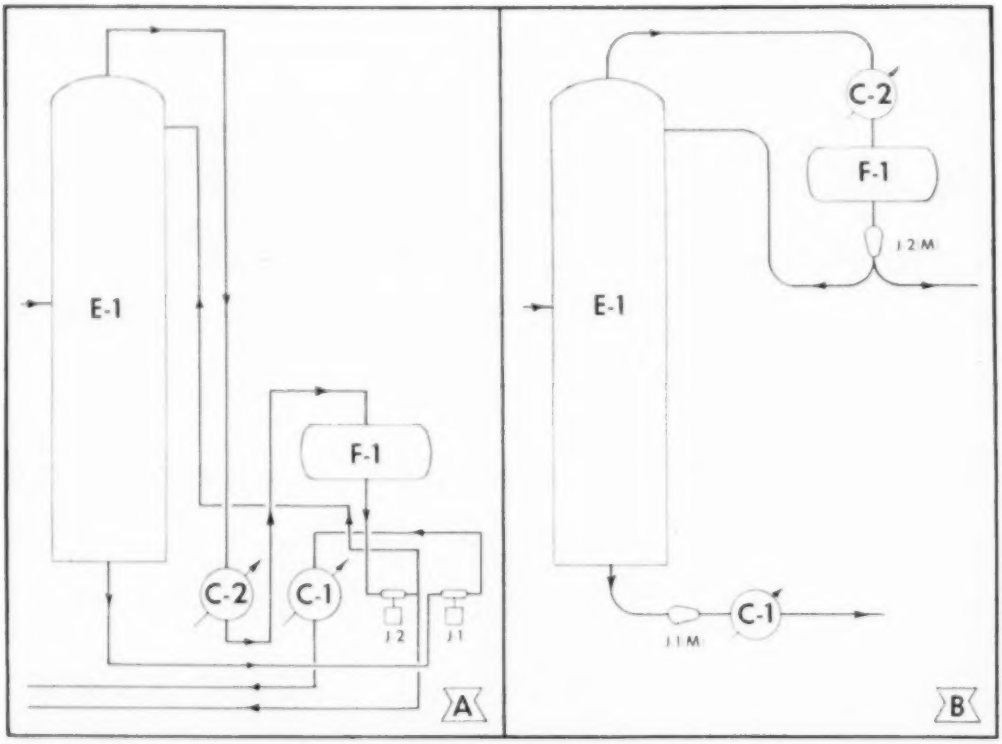
Application of the algae-killer varies with conditions. Because the algae grows faster in the hotter towers than in the cooler ones, the treatment may be given more frequently or intensely. Usually the treatment is administered twice a week for a 45-minute period at each operating installation. During the winter, as the needs decline, weekly applications may be sufficient.

Because control is important to avoid waste, the pumps are calibrated so the desired yield is produced. In exceeding the recommended 4-6 ppm formula, an unduly heavy discharge may create a brown haze, indicating that bromine is being wasted.

Glass apparatus is generally used as a means of metering and mixing the bromine and water because of corrosive action. An adaptor is bolted to the filling nozzle of the bromine drum, and the injector is fixed to it. The steel drum and attached pump are encased in a box at the foot of a cooling tower. The special GP aspirators are made in the refinery shop by Mr. Thomson, co-inventor.

General Petroleum selected bromine for algae extermination because algae doesn't develop an immunity to it, as it does to chlorine, and because it has better staying power than chlorine, which evaporates easily.

Since bromine costs about twice as much as chlorine (21c per lb. and 11c per lb., respectively), it was necessary that it be twice as effective. In GP's case, it has been that; and with the new economy, it is even more attractive.



HARD TO FOLLOW is this conventional flow chart. **EASY TO FOLLOW** is the same chart in simplified form

How to Simplify Your Flow Sheets

THE basic reason for process flow sheets and process control diagrams is to pass on to the user a good conception of what is happening in a process and how it is being controlled.

Why not make them perform that function then? Why not make them quickly and easily read by any engineer, supervisor, or management man in the plant." Thus reasoned W. L. Willoughby of Cities Service Refining Corp., at Lake Charles, La. The results of his thinking were presented to the 1952 Symposium on Instrumentation for the Process Industries at Texas A & M College in June. Typical methods of simplification are shown in the drawings above and on the next two pages.

Essential features of Willoughby's system are:

1. Eliminate confusing line crossings.

2. Use curves for intersections to denote flow direction.

3. Simplify equipment symbols, such as those for pumps.

4. Make instrument lines *non*-parallel to process lines.

5. Forget the actual physical location or relationship of various pieces of equipment.

For example: drawing *A* above is a typical process flow sheet. Too much emphasis was placed on the equipment's location instead of on making a simple process diagram. The reader is immediately confused by excess lines and line crossings. Drawing *B* shows the confusion eliminated. Smooth lines and curves put across the feeling of flow direction. New pump symbols also point out flow direction. Both *A* and *B* describe the same process, yet *B* can be read and understood in a fraction of the time required for *A*.

Instrumentation has been added in drawings *C* and *D* to the same process. Further confusion results in the conventional diagram at *C*, where the instrument air lines, shown dotted, run parallel to and across various process lines.

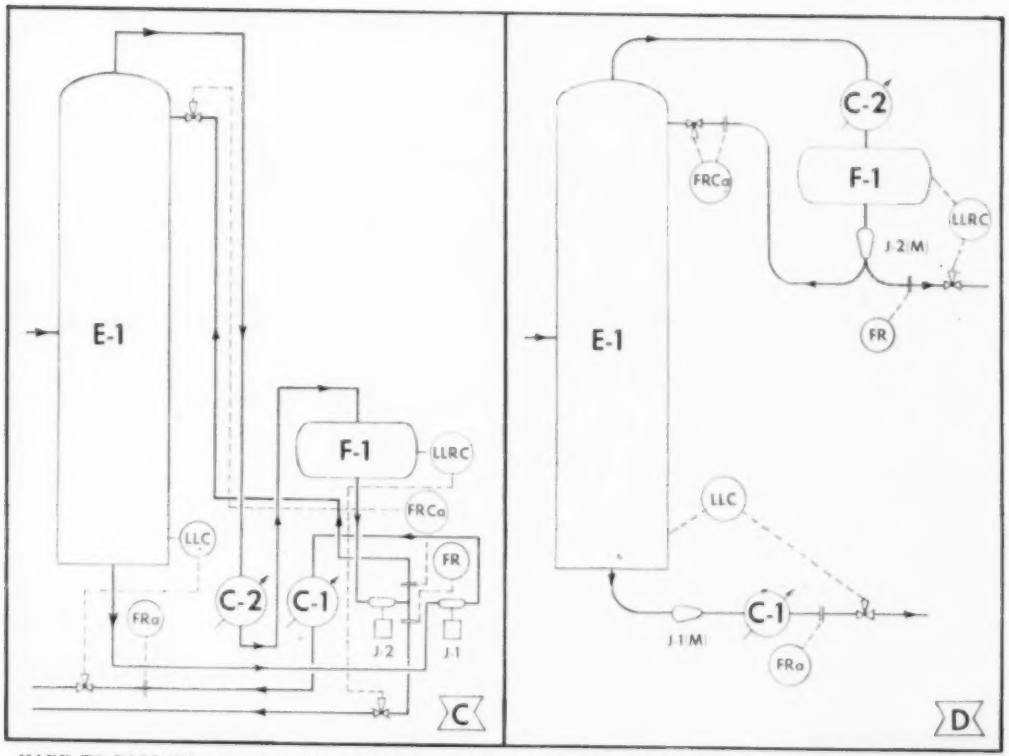
On the other hand in *D*, the instrument lines never run parallel to the process lines. In fact, in some cases instrument symbols can be used to indicate flow directions. This is done by sloping the dotted air lines from the symbols to the valves or the pressure or temperature points in the direction of the process flow. Thus, the result is a clear concise picture of the process and how it is controlled.

Compared with Highway Planning

An analogy with modern highway designing was used by Mr. Willoughby to illustrate his point:

"In past years the highway engineers designed city streets and highways on the same basic pattern, that is, having a maximum of intersections with all square turns. This caused much confusion on the part of the driver, because he had to stop to make a decision every time he came to a road crossing, reducing his speed. Very little has been done to improve city traffic conditions.

"However, great strides are being made in improving traffic conditions



HARD TO FOLLOW is this conventional process control sheet

EASY TO FOLLOW is the same diagram when simplified

and Process Control Diagrams

on the highways by the use of one-way traffic lanes and the elimination of square turns (The Draftsman's Delight). The result is a speed-up in traffic, reduction in accidents, and a reduction to a minimum in driver fatigue.

"The layout of highways and city streets can be readily compared with the process and engineering flow sheets used by most process industries. One has smooth flowing lines causing the driver or reader little mental effort. The other is a maze of sharp turns and intersections, causing "stop-and-go" driving or reading, as the case may be. The result is mental fatigue, increasing the chance for human error.

"First, let us define the most common flow sheets. The process flow sheet is a simple diagram, setting forth the basic idea of the process, omitting auxiliary lines and instrument symbols.

"The instrument or process control diagram is essentially the process flow sheets with instrumentation added.

"The engineering flow sheet is a detailed process flow sheet. All process equipment, instruments, valves, and piping are shown. This type is used primarily by project engineers and draftsmen for making estimates and detailed drawings.

"The engineering flow sheet is similar to a layout of city streets. It must be studied very carefully to understand the basic process idea because that idea is so well hidden behind the intersections, sharp turns, and necessary details.

"On the other hand, the process flow sheets and control diagrams can be compared with the improved highway layouts. There are no sharp turns or intersections. Details have been purposely avoided. The drawing should be made with considerable forethought, giving the person studying it the basic idea of what is happening in the process. If this scheme is followed in drawing the flow sheets, all persons involved will have a better conception of the process. This technique is certain to save many manhours of mental effort.

"The instrument applications engineer should have a clear simple picture of the process before he starts to apply the controls. If the picture is clear with good continuity, his job will be easier and the end results much more satisfactory.

The technical service man or the process engineer will study a flow sheet or control diagram in the light of what information will be made available for the evaluation of the process. He uses instruments for tools and fact-finders to determine the effects of certain changes on yields, quality, etc.

"Many men in the field have to read flow sheets at one time or another. The unit process engineer uses them constantly. Some foremen and instrumentmen, like operators, seldom have the occasion to use them after a unit is in operation and they have become familiar with the process. The best use of these sheets in an instrument department is in the case of new personnel or men transferred

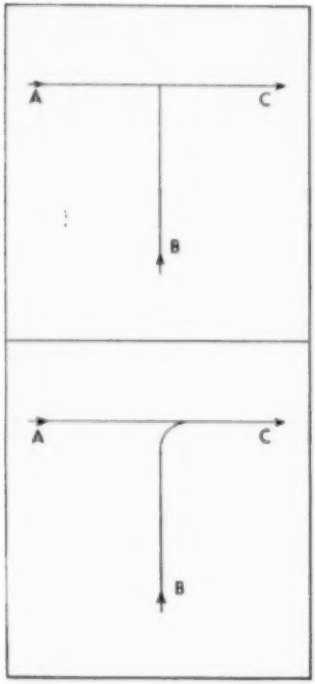


FIG. 1 — Conventional intersection, above, and improved junction, below

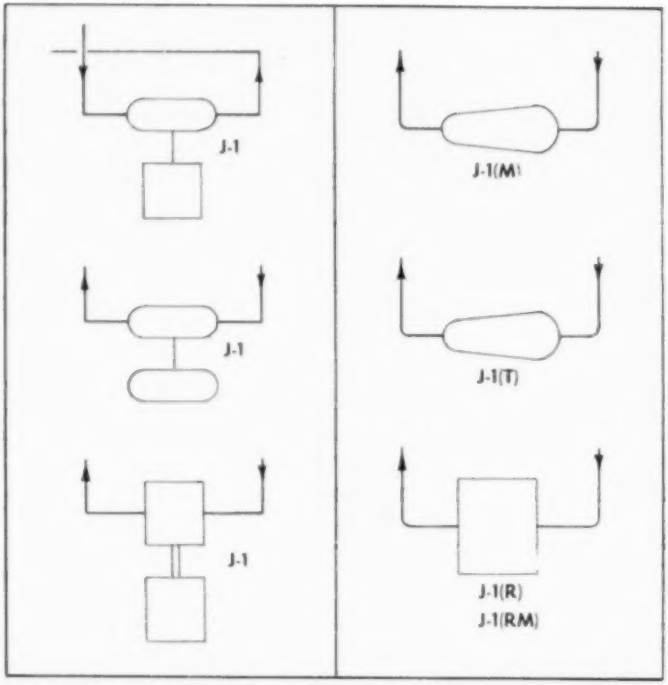


FIG. 2—Conventional pump symbols, left, and improved symbols, right

from other jobs, because they can become familiar with the process in a minimum of time.

"Trained in this way, a man can generally be counted upon to pick up physical location of his equipment in a very short time. The average instrumentman would have to be a genius to be able to remember all the types of operation and control in a normal plant, but with the aid of a good control diagram he can generally find the trouble."

Two major features of the flow sheet simplification method are illustrated in Figs. 1 and 2. A standard intersection of one line with another is shown at the left in Fig. 1. Starting at point *B*, and following toward the junction, it can be seen that the reader is forced to stop and think, not knowing whether to turn toward point *A* or *C*.

However, in the curved intersection example, shown at the right in Fig. 1, there is no confusion. The eye quickly follows the curve and proceeds directly from *B* to *C*.

Another method of reducing confusion is shown in Fig. 2. The symbols at the left are of no help in indicating flow direction. In addition the lines make square turns, and in one case, they cross. At the right a pear-shaped pump symbol is depicted. The suction side is the large end of the pear and the discharge is the small end. Type of pump is indicated by merely adding a letter or two to the equipment designation.

The effect of the Willoughby idea on an even larger diagram is illustrated in Figs. 3 and 4. Fig. 3 is an engineering flow sheet for a three-tower group. This type of flow sheet is of no immediate use to the process or instrumentman. It is too detailed. The project engineer and draftsman require this type. They can estimate the cost of the unit, because all major and minor pieces of equipment are shown, as well as instrumentation. Auxiliary sheets are still necessary for steam and water lines. In Fig. 4, the same three-tower group is shown with all control instruments and major pieces of equipment. Yet it is so arranged as to be easily read and understood.

There are some cases where several symbols are used to indicate only one instrument; that is, there are symbols for the transmitter, the receiver-recorder, the alarm, and any other part that may have been added to the basic instrument. These needless symbols only make the diagram more difficult to use. One symbol with the proper designation will usually explain the control instrument required.

The designation for heat exchangers or condensers should be such that the person reading the sheet would know what flowing medium is on the shell side and what is on the tube side. This can be done by using a dotted line within the exchanger or condenser circle to indicate flow through the tubes. The water flow through a cooler is usually indicated by an arrow diagonally upward through the cooler symbol from left to right.

Another common use of process flow sheets is in the preparation of "flag sheets" which show the important operating variables on an operating unit. These data will include flowing medium, gravity, temperature, and pressure at important points throughout the unit. The data is recorded from actual operation and serves as a record for study by operating personnel, executives and others interested. Due to the limited amount of time such people have for study of this type, it is very desirable that only essential information be presented on such a "flag sheet" and therefore a simplified flow sheet is ideally suited.

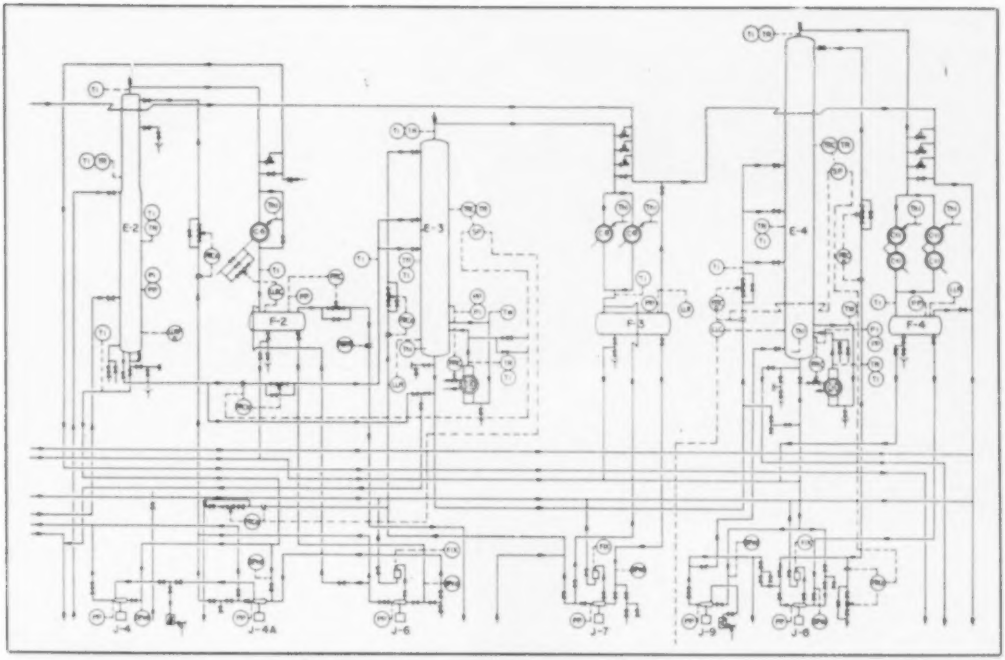


FIG. 3—Conventional engineering flow sheet for a typical process

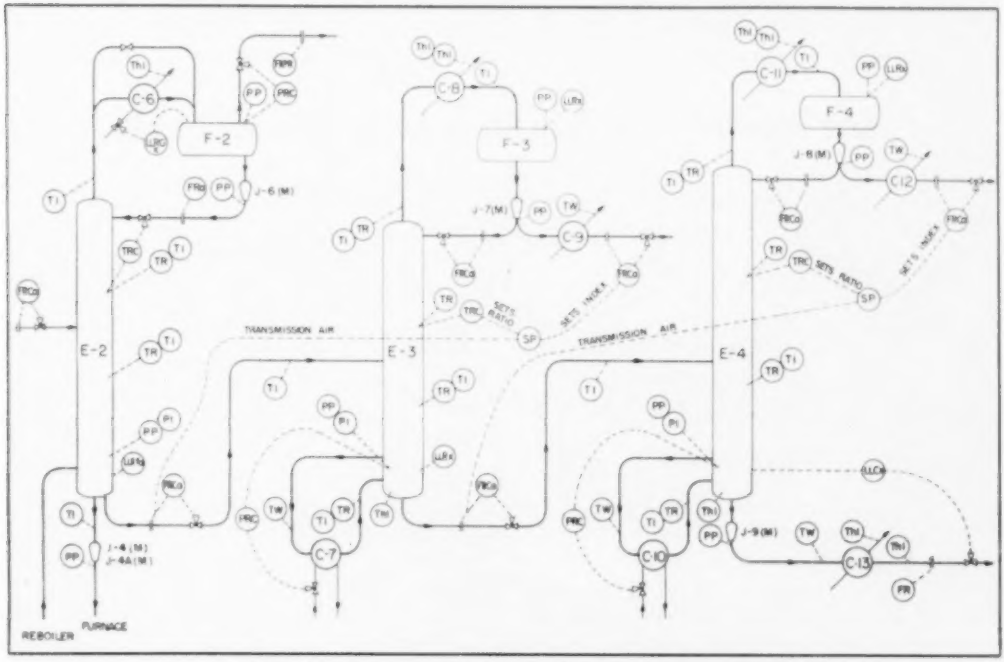
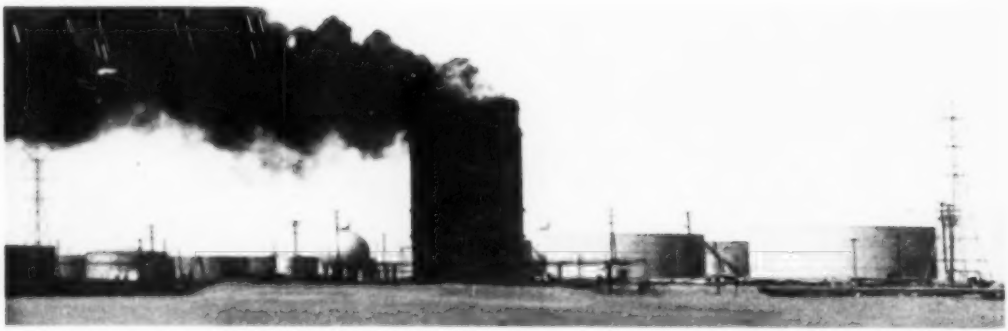


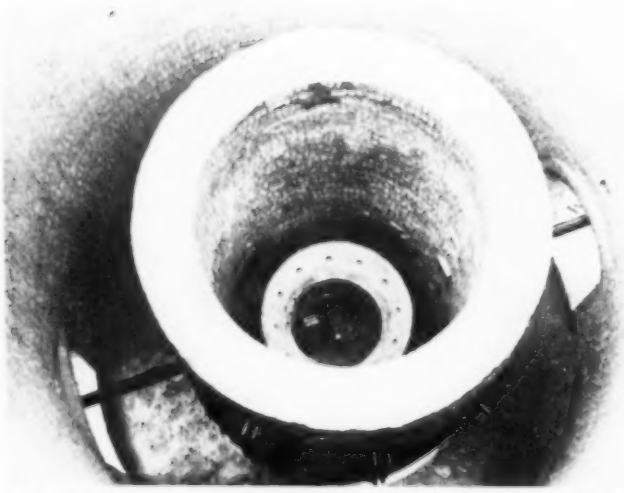
FIG. 4—The same process as shown with a simplified flow sheet



WITHOUT WATER SPRAY INJECTION this new flare at Esso's Bayway, N. J. refinery smokes to high heaven

BUT WITH WATER SPRAY the same stack flaring the same amount of gas is practically smokeless

New Type Refinery Flare Stack Burns Without Smoke

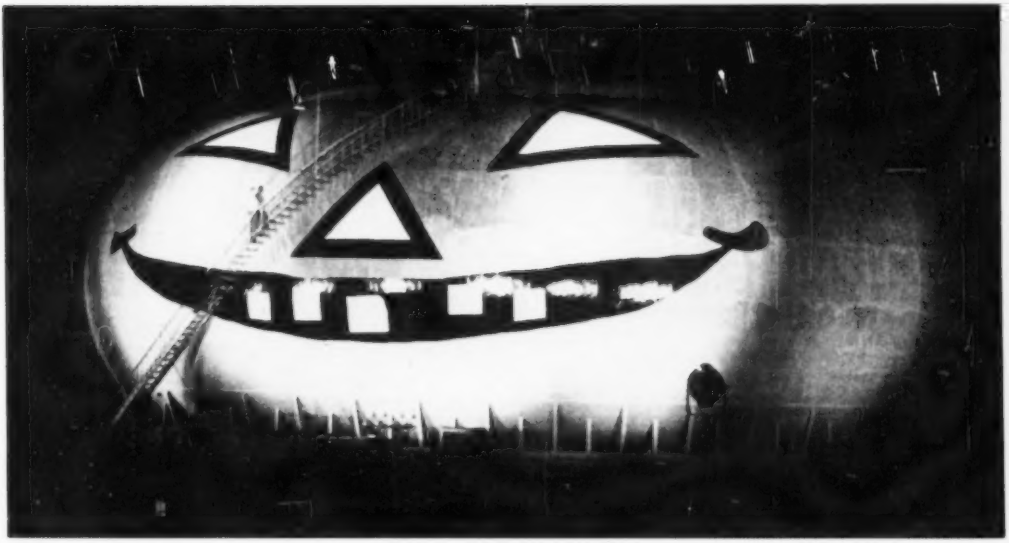


INSIDE VIEW shows three concentric masonry stacks for mixing gas and water (smallest), combustion, and final flaring (largest)

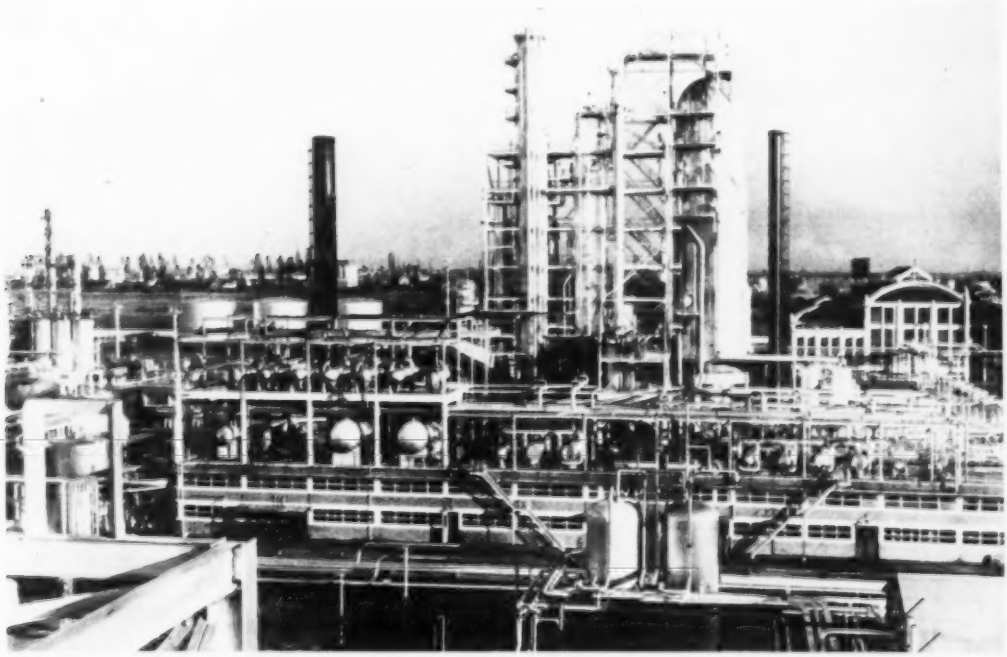
EFFECTIVENESS of a highly atomized water spray in eliminating smoke in a new ground-type safety flare stack has been demonstrated at the Bayway refinery of Esso Standard Oil Co. in Linden, N. J. The flaring of equal amounts of gas first without and then with water spray injection is shown in the pictures above. Without water the stack smoked; with water added it didn't.

The flare effects smokeless burning by introducing gas and water under pressure prior to ignition.

It is constructed of three concentric masonry stacks, the largest of which is 30 ft. high and 14 ft. in diameter, which permit the introduction of gas and water spray, combustion, and final flaring in gradual stages. Gas and water are combined in the small innermost stack. As they emerge, two pilot lights ignite the mixture for initial combustion in the second stack. The third stack affords a larger area and better draft for the final flaring, thus confining the entire operation within the flare itself.



Largest 'Jack O' Lantern' in world was formed from 80,000-bbl. roofed Hortonspheroid under construction at Wilmington, Calif., refinery of Union Oil Co. of California. Prime coats of orange paint gave the squat tank the appearance of a pumpkin, which led to suggestion nightly during spook week, the jack o'lantern leered at nightly during spook week, the jack o'lantern leared at passing motorists. Eyes measure 16 x 18 ft., mouth is 73 ft. long and 10 ft. high, and teeth are each 4 ft. square. In normal usage tank holds natural gasoline.



Rebuilt Dunkirk Refinery in France was dedicated Oct. 9, by Anglo-Iranian Oil Co. New plant, on site of one almost totally destroyed during World War II, cost $50,000,000 and has a capacity of 40,000 b/d, four times that of its predecessor. In background above are beaches from which British evacuated troops in 1940.

Accuracy in Sizing Control Valves

By RALPH A. ROCKWELL*

THE determination of a control valve size for a given application is not an exact science. While it is always premised on a full knowledge of actual flow conditions, frequently one or more of the conditions are by necessity approximations. It is the evaluation of these flow data, therefore, that really determines the final valve size. Common sense and experience are the prime requisites.

The use of the valve flow coefficient, C_v, materially simplifies the problem of control valve sizing. This C_v provides a simple method applicable to a wide variety of valve constructions, valve sizes, and field services, and because of its importance, and understanding of its development, scope and limitation is essential.

The valve flow coefficient is the number of U. S. gallons per minute of water which will pass through a given flow restriction with a pressure drop of 1 psi. It is a capacity index. Any flow problem for gas, steam or liquid can be converted to the equivalent valve flow coefficient. In other words, the flow of any fluid through a restriction with a known pressure drop may be expressed in terms of gpm. of water at 1.0 psi. pressure drop. This flow restriction can be an orifice plate, a length of pipe, a hand valve or, more specifically for control purposes, an automatic control valve. The C_v does not involve any specific flow restriction, but is based on the fundamental law of fluid flow: $v = \sqrt{2gh}$. All sizing formulas, slide rules, alignment charts, and tables are based on this simple law.

For liquids, C_v is equal to the flow in gpm. divided by the square root of the pressure drop in psi. and is corrected for specific gravity by multiplying this expression by the square root of the actual flowing gravity. For steam and gases, the use of C_v is almost equally simple. In the gas and steam equations, suitable constants permit the use of C_v and convenient units for flow, pressure, temperature and specific volume.

A control valve which has a C_v of 10 means that its effective port area (in the fully open position) is such that it passes 10 gpm. of water with a 1 psi. pressure drop. This is the approximate C_v capacity of a 1-inch control valve. The numerical value of C_v simply expresses the number of gallons per minute of water flow which would result from a 1-psi. pressure drop.

The maximum flow capacity of a valve is a complex function of the port area, plug design and body design. Valve efficiencies are dependent upon the valve design, the flow pattern and the ratio of the port area to the body area. In view of the wide variety of designs and the extreme difficulty in determining the valve efficiency, it is generally impractical to calculate the valve flow coefficient and all capacity data should be determined experimentally.

The C_v rating of a valve is always specified at the rated lift or in the wide open position. Valve flow characteristics are frequently plotted in terms of lift versus C_v. The valve rating is then the C_v at 100% lift, and the use of C_v for all other lifts is a convenient way of expressing flow at a constant drop.

Assumptions Must be Reasonable

It should be recognized that present valve sizing procedures are based on assumptions that are not strictly valid and on theory which in many instances is inadequate. However, without the use of simplified theory and reasonable assumptions the practical problem of sizing becomes hopelessly complicated. Although C_v is based on experimental data and makes corrections for body losses and efficiency of the port and passages, the experimental determination of its value does not take into account the variations in the characteristics of the fluids in question; nor does it allow for changes in the state of the fluid or the wide variations of pressure drop and velocity which may exist in various installations. It is in this region that the rule of the thumb, based on experience and rational assumptions is necessary.

Improved techniques and more exact determinations of the behavior of fluids under various pressure drop conditions may improve the theoretical accuracy, but the over-all accuracy will still be limited somewhat by the difficulty of evaluating operating conditions.

With the exact maximum flow known, it is customary and desirable to provide a safety factor and to determine the valve size on an arbitrary flow usually well in excess of the known maximum. This excess is dependent on the operating conditions of the application, the valve size and the construction of the valve under consideration.

Sizing procedures are predicated on reasonably exact knowledge of the pressure drop across the valve. In many instances the actual pressure drop used is at best only an approximation and, therefore, care must be exercised to select the average pressure drop consistent with operating conditions at the maximum flow.

While sizing formulas are based on the assumption that the flow varies as the square root of the pressure drops, there is some question as to the validity of the application of the square root law to such a complex restriction as a control valve, especially under extreme operating conditions. Except in unusual circumstances, the error resulting from the use of the square root law is seldom of sufficient magnitude to justify complicating the sizing procedure by corrections which, in many instances, may be extremely difficult to correlate to the case at hand.

The formulas for steam and gases include a compressibility correction which is a function of the outlet pressure psia, P_2. This is an assumption which is not strictly true as the exact correction should be some intermediate value between the inlet and outlet pressures. The use of the outlet pressure is a conservative simplification tending to underrate the valve capacity up to approximately 15% at the critical pressure ratio.

Correct Interpretation Imperative

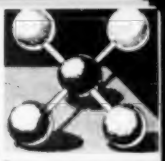
After the C_v has been determined, there still remains the task of selecting the optimum valve size from both a performance and economic point of view.

For example, if a C_v of 32 is obtained, and requirements call for a double-seated, diaphragm motor valve, the choice must be made between the 1½-in. size with a C_v of 30 and the 2-in. size with a C_v of 50. At this point, good judgment dictates a review of the operating data as a guide to the final size selection.

In the foregoing example, if the value of the flow used in figuring the formula included a substantial safety factor, or if the pressure drop was lower than could be reasonably expected, the use of the 1½-in. valve would probably meet all the performance requirements at a minimum cost. On the other hand, if very accurate flow and pressure drop figures were available and used without the addition of a safety factor, it would be wise to select the 2-in. size.

This guess-estimating of the final valve size emphasizes the futility of worrying about small theoretical corrections which actually serve no useful purpose in the final selection of the valve.

* Ralph A. Rockwell, recently appointed technical consultant for the Valve Division, Minneapolis-Honeywell Regulator Co., has a 30-year background in the instrument and automatic control industry. Prior to joining M-H, he was director of engineering for Mason-Neilan, where he was responsible for a variety of devices including a diaphragm valve and liquid level controller. He holds numerous patents and has authored many technical papers.



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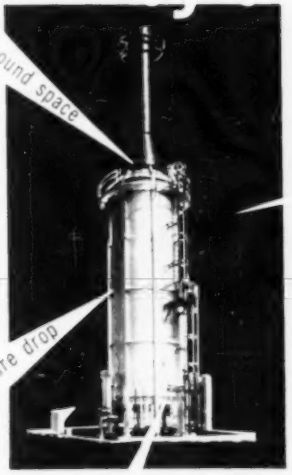

is a significant feature of all Petro-Chem Iso-Flow Furnaces . . . their design includes vertical tubes which completely cover the interior wall surface thus maintaining a low wall temperature. The low wall surface temperature greatly lengthens the life of the refractory and insulation . . . their even heat characteristic eliminates hot spots on tubes . . . these low maintenance factors highlight the experience of more than 1,000 installations demonstrating that *low maintenance* is assured with all Petro-Chem Iso-Flow Furnaces.

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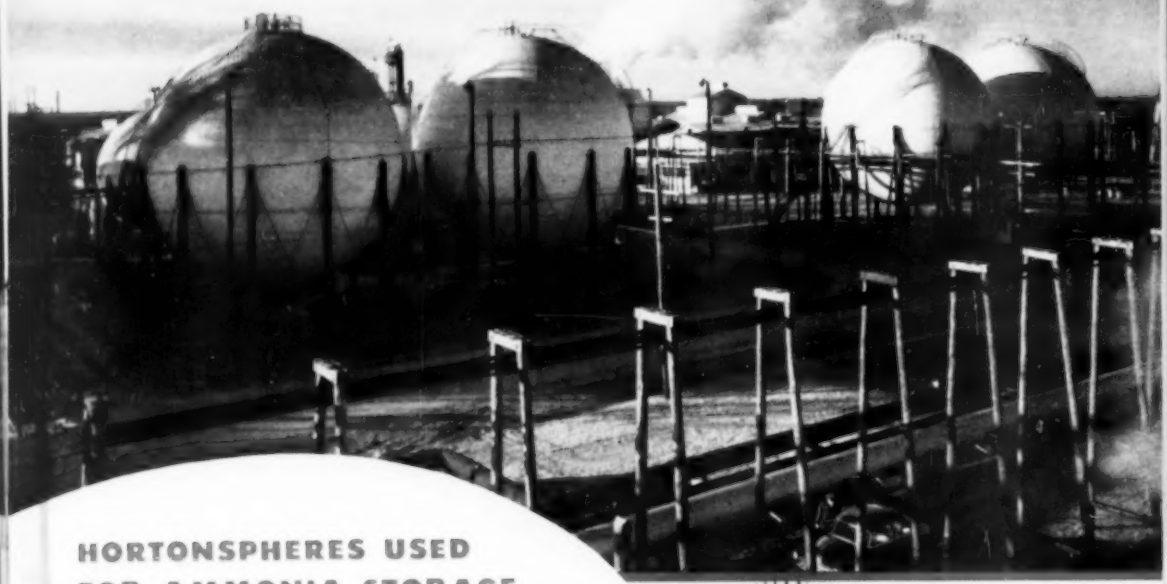
PETROCHEMICAL PRESSURE STORAGE



HORTONSPHERES USED FOR AMMONIA STORAGE

Natural gas has taken on a new, significant role in the huge petrochemical plant of Spencer Chemical Company at Military, Kansas. It is the role of a "starting ingredient" in manufacturing four valuable commercial materials—ammonia, ammonium nitrate, methyl alcohol, and dry ice.

Ammonia must be stored under pressure to prevent loss by evaporation. Spencer Chemical Company uses Hortonspheres to solve this problem. Flowing from their synthesis equipment, the ammonia is cooled and then stored in Hortonspheres at 75 lbs. per sq. in. pressure.

Designed to withstand internal pressure, Hortonspheres do not vent vapor as long as the internal pressure does not exceed the setting of the pressure relief valves. Installations for ammonia storage are usually equipped with return lines which carry vapors back into production lines for repressuring and cooling when venting does take place.

Hortonspheres are built in capacities up to 30,000 bbls. for pressures up to 215 lbs. per sq. in. in the smaller capacities. Write our nearest office for further information or quotations.

Four 15,000-bbl. Hortonspheres (top view) and four 5,000-bbl. Hortonspheres (bottom view) all designed for a working pressure of 75 lbs. per square inch.

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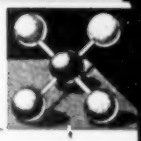


Table 1—Petrochemical Expansion Goals Established by Defense Production Administration

Petrochemical	Capacity 1/1/51	Goal 1/1/55	Amt. Expansion	% Expansion
	(millions of lbs.)			
Butadiene	61.0	162.0	101.0	165.6
Carbon Black	1,520.0	2,320.0	800.0	52.6
Carbon Tetrachloride	224.0	331.0	107.0	47.8
Ethyl Chloride	430.0	630.0	200.0	46.5
Ethylene Dibromide	120.0	210.0	90.0	75.0
Ethylene Glycol	653.0	850.0	197.0	30.2
Ethylene Oxide	546.0	969.0	423.0	77.5
Formaldehyde	1,325.0	1,675.0	350.0	26.4
Glycerine	225.0	278.0	53.0	23.6
Methyl Chloride	34.0	72.0	38.0	111.8
Methylene Chloride	39.0	109.0	70.0	179.5
Nitrogen Materials	3,278.0	5,860.0	2,582.0	78.8
Octyl Alcohols	107.0	167.0	60.0	56.0
Pentaerythritol	40.0	65.0	25.0	62.5
Perchlorethylene	105.0	180.0	75.0	71.4
Phenol	343.6	623.6	280.0	81.5
Styrene	626.0	1,210.0	584.0	93.3
Trichlorethylene	277.0	400.0	123.0	44.4
	9,953.6	16,111.6	6,158.0	61.9
	(millions of gals.)			
Benzene	215.0	375.0	160.0	74.5
Ethanol	398.0	410.0	12.0	3.0
Methanol	174.0	226.0	52.0	29.9
Toluene	83.0	185.0	102.0	123.0
	870.0	1,196.0	326.0	37.5

Expansion Goals 99.7% Filled

Over $800 million investment authorized to meet production needs on 22 petrochemicals

WHERE does the petrochemical industry stand today in meeting the production goals set up in the nation's preparedness program?

The Defense Production Administration last June announced expansion needs for 52 critical chemicals. A survey by PETROLEUM PROCESSING showed that 22 of these compounds were petrochemicals, made from petroleum or natural gas materials. Their increased production is to come from 157 projects authorized by DPA since the start of the defense mobilization program in September 1950. These plants have a capitalization of over $800 million.

For 18 of these petrochemicals required in the emergency program, where volumes are figured in pounds, a total of 16,111,600,000 lbs. has been set for January 1, 1955. This represents about 62% greater production for plants making these chemicals than on January 1, 1951.

For the remaining four of the 22 petrochemicals where volumes are figured in gallons (benzene, toluene, methanol and ethanol), the production goal of 1,196,000,000 gals. for 1955 is nearly 38% greater than the 1951 production of 870,000,000 gals. Table 1 shows details of the DPA expansion program for the 22 petrochemicals figuring in the industrial mobilization program.

Tables 2 to 26, on the following pages, give the information on the individual petrochemical projects undertaken by 81 different companies. The data, showing certified dollar values and plant statuses, were compiled by PETROLEUM PROCESSING from information obtained in the survey. Certification figures were either confirmed by the companies or DPA.

Table 2 on acrylonitrile, Table 9 on ethylene, Table 24 on sulfonates, and Table 26 covering miscellaneous petrochemicals, give data on those petrochemicals as yet unprogrammed by DPA.

A difficulty arose when trying to determine whether some projects were actually petrochemical. For example, in Tables 21 and 25, the raw material listed by Hooker-Detrex Inc. for the manufacture of perchlorethylene and trichlorethylene is acetylene. The usual source of acetylene is carbide, but information on the returned questionnaires did not indicate whether the source was carbide or natural gas. Therefore, all chemical projects which *could* be petrochemical are included in this report to give the complete picture on particular chemicals.

The amount authorized to date by DPA provides for building the necessary facilities in meeting 99.7% of petrochemical expansion goals. Yet to be filled is 12% of the methylene chloride goal, or 13 million lbs. which has been reserved for

small firms of one thousand employes or less. Open in the perchlorethylene goal is 8.1 million lbs. in the programmed 180 million lbs., and 23 million lbs. are still unfilled in the goal for synthetic glycerine.

Of the 179 DPA authorized projects reported on in this report, 22 of which are on unprogrammed petrochemicals, survey findings show:

1) 45 petrochemical plants are completed and in operation;

2) 20 are 75% or more completed;

3) 7 are 50-75% completed;

4) 16 are 25-50% completed;

5) 2 are less than 25% completed;

6) 25 have not been started but are in design and engineering stages.

No information, except confirmed dollar values, is available on the remaining 64 plants. Over and above the 179 authorized projects, four applications have been withdrawn and one temporarily abandoned.

Five Leading Companies

Five chemical companies are authorized to invest about one-third of the total amount certified by DPA on petrochemical projects. Carbide and Carbon Chemicals Co. lead the parade with $109 million (9 certificates covering 10 petrochemicals); Dow Chemical Co. is second with $67 million, (19 certificates on 10 petrochemicals); Allied Chemical and Dye Corp. is third with $49 million, (4 certificates on 6 petrochemicals); Monsanto Chemical Co. is fourth with $43 million, (8 certificates on 10 petrochemicals); and fifth, Phillips Chemical Co. with $35 million, (5 certificates on 4 petrochemicals).

Top oil company is Lion Oil Co. with $30 million on a single certificate for nitrogenous fertilizers at Luling, La. Cities Service Refining Co. follows with one certificate at $28 million. Union Oil Co. is next with almost $18 million on three projects, and Gulf Oil is next with about $17 million on four certificates. In all, 20 oil companies are involved in certified projects of slightly more than $200 million, the remainder, about $700 million, being taken up by chemical firms.

It should be pointed out that amounts included in the tables represent only amounts under the DPA mobilization program.

Table 2—Acrylonitrile

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Carbide and Carbon Chemicals Co. Institute, W. Va.	$7,507,597*	New plant; in operation		Natural Gas
Monsanto Chemical Co. Texas City, Texas	$25,633,000*			

* Amount covers more than one chemical.

Table 3—Benzene, Toluene, Xylene

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Aromatics Refining Co., Inc. Baton Rouge, La.	$11,630,000*			
Atlantic Refining Co. Philadelphia, Pa.	$5,600,000[2]			
Atlas Processing Co. Shreveport, La.	$3,500,000	Complete Sept. 1952	Hudson Engrg. Corp. Procon Inc.	100-140° F. boiling range raw naphtha
Cosden Petroleum Corp. Big Spring, Texas	$2,950,000	New plant; complete Sept. 1952; in operation	Procon Inc.	Naphthenes from West Texas crude
Dow Chemical Co. Freeport, Texas	$1,100,000			
Deep Rock Oil Corp. Cushing, Okla.	$3,400,000*			
Eastern States Chemical Corp. Houston, Texas	$554,097	In operation	Brown and Root	Platformate
Esso Standard Oil Co. Baton Rouge, La.	$3,040,000*	New plant and addition to existing facility; 75% complete; est. compl. 1953	H. E. Wiese, Inc.	Refinery gases and cracked distillate
Great Southern Chemical Co. Corpus Christi, Texas	$4,000,000[3]			
Honolulu Gas Co., Ltd. Honolulu, Hawaii	$743,427[4]	New plant; complete; in operation		Manufactured oil gas
Humble Oil & Refining Co. Baytown, Texas	$64,941	Addition to existing facility; complete; in operation	Own forces	Gasoline
Koppers Co., Inc. Kobuta, Pa.	$181,027	Addition to existing facility; 75% complete; est. compl. Nov. 1952	Own forces	Light oil
Monsanto Chemical Co. St. Louis, Mo.	$650,000			
Old Dutch Refining Co. Muskegon, Mich.	$326,100[5]			
Pan American Refining Co. Texas City, Texas	$1,100,000	Application withdrawn		
Roosevelt Oil and Refining Corp. Mt. Pleasant, Mich.	$1,500,000[3]	Addition to existing facility; 75% complete; est. compl. Dec. 1952	Procon Inc.	Straight run gasoline
Shell Oil Co. Wilmington, Calif.	$100,000	Change in existing facility; 50% complete; est. compl. Feb. 1953	Own forces	Refinery gases
Shell Oil Co. Harris County, Texas	$2,720,000	New plant; 75% complete; est. compl. Dec. 1952	Fluor Corp.	
Shell Oil Co. Houston, Texas	$10,400,000	New plant; 75% complete; est. compl. 1st Q. 1953	Foster Wheeler and Procon Inc.	Refinery gases
Shell Oil Co. Wood River, Ill.	$150,000[3]	Revision in existing facility; 50% complete; est. compl. June 1953	Own forces	Refinery gases
Standard Oil Co. (Calif.) El Segundo, Calif.	$14,000,000[3]			
Standard Oil Co. (Calif.) Richmond, Calif.	$1,187,000			
Standard Oil Co. (Ind.) Whiting, Ind.	$1,170,000	Addition to existing facility; 75% complete; est. compl. Oct. 1952		Light naphtha
Sun Oil Co. Marcus Hook, Pa.	$8,380,000	New plant; 75% complete; est. compl. mid-1953	Own forces	Straight run gasoline fractions
Union Oil Co. of Calif. Wilmington, Calif.	$12,000,000[3]	In the engineering stage; construction has not begun		

* Amount covers other chemicals.
[2]—amount covers benzene, toluene, and xylene
[3]—amount covers benzene and toluene
[4]—amount covers xylene only
[5]—amount covers toluene only
[6]—amount covers provision for expansion of power facilities for benzene, ethylene, and ethyl chloride plant

Table 4—Butadiene

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Carbide and Carbon Chemicals Co Texas City, Texas	$893,300	Completed Jan. 1952		Refinery gases
Dow Chemical Co Freeport, Texas	$3,480,000	n.a.		
Dow Chemical Co Midland, Mich.	$136,400	n.a.		
Firestone Tire and Rubber Co Pottstown, Pa.	$961,500*			
Jefferson Chemical Co Port Neches, Texas	$145,000	Addition to existing facility; complete; in operation	Own forces	Refinery gases
Pennsylvania Industrial Chemical Corp. Chester, Pa.	$7,640,000*			
Publicker Industries Inc Eddington, Pa.	$4,309,000			

* Amount covers more than one chemical
n.a.—not available

Table 5—Carbon Black

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Cabot Carbon Co Ville Platte, La.	$732,028			
Cabot Carbon Co Centerville, La.	$1,097,475			
Cabot Carbon Co St. Mary Parish, La.	$1,847,080			
Cabot Carbon Co Bayou Sale (St. Mary Parish), La.	$2,174,380			
Cabot Carbon Co Bayou Sale, La.	$370,650			
Columbian Carbon Co El Dorado, Ark.	$1,670,000			
Columbian Carbon Co Conroe, Texas	$395,000			
Continental Carbon Co Sunray, Texas	$82,706			
Continental Carbon Co Hobbs, N. M.	$1,010,500			
Continental Carbon Co Sunray, Texas	$185,000			
Continental Oil Black Co Westlake, La.	$2,090,500	New plant; complete; in operation		Distillate Residual oil
General Atlas Carbon Co Pampa, Texas	$152,181			
General Atlas Carbon Co Big Spring, Texas	$1,545,050			
J. M. Huber Corp. Eldon, Texas	$2,211,242	New plant; complete; in operation	Stearns Roger Mfg. Co.	Oil
Phillips Chemical Co Borger, Texas	$4,668,999	Addition to existing facility; complete; in operation	Own forces	Liquid hydrocarbons
Phillips Chemical Co Borger, Texas	$479,500	Addition to existing facility; 25% complete; est. compl. March 1953	Own forces	
Phillips Chemical Co Borger, Texas	$2,395,900	New plant; 50% complete; est. compl. 4th Q. 1952	Own forces	Liquid hydrocarbons
Sid Richardson Carbon Co Fort Worth, Texas	$2,000,661			
Thermatomic Carbon Co Sterlington, La.	$985,110	Addition to existing facility; construction not started		Natural gas
Thermatomic Carbon Co Sterlington, La.	$198,500	Addition to existing facility; 50% complete; est. compl. Dec. 1952		Natural gas
United Carbon Co. Inc Lake Charles, La.	$2,790,000			
United Carbon Co. Inc St. Mary Parish, La.	$2,655,500			
United Carbon Co. Inc Wheeler, Texas	$1,907,500			

Table 6—Carbon Tetrachloride

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Dow Chemical Co Freeport, Texas	$4,475,000*			
Stauffer Chemical Co Louisville, Ky.	$2,524,000*			
Stauffer Chemical Co Niagara Falls, N. Y.	$5,155,000			

* Amount covers more than one chemical

Table 7—Ethyl Alcohol

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Carbide and Carbon Chemicals Co Institute, W. Va.	$7,507,597*	New plant; in operation		Natural gas
Texas Eastman Co Longview, Texas	$5,787,000	New plant; 95% complete; in operation		Natural gas
U. S. Industrial Chemicals Inc Baltimore, Md.	$328,815			

* Amount covers more than one chemical

Table 8—Ethyl Chloride

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
American Petrochemical Corp Lake Charles, La.	$26,640,000*			
Dow Chemical Co Freeport, Texas	$3,535,000*			
E. I. du Pont de Nemours & Co. Inc Deepwater Point, N. J.	$400,000	Addition to existing facility; complete; in operation		
National Petro-Chemicals Corp Tuscola, Ill.	$6,515,950	New plant; construction not started; est. compl. July 1953	Foster Wheeler	Natural gas and ethylene
Shell Chemical Corp Houston, Texas	$1,441,900	Addition to existing facility; complete; in operation	Fluor Corp.	Ethylene
Shell Chemical Corp Houston, Texas	$9,500,000	Application withdrawn		
Shell Oil Co Harris County, Texas	$2,720,000**	New plant; 75% complete; est compl. Dec. 1952	Fluor Corp.	

* Amount covers more than one chemical
** Amount covers provision for expansion of power facilities for benzene, ethylene and ethyl chloride plant

Table 9—Ethylene

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
American Petrochemical Corp Lake Charles, La.	$26,640,000*			
Crown Central Petroleum Corp Pasadena, Texas	$265,000			
Dow Chemical Co Freeport, Texas	$6,675,000			
Dow Chemical Co Midland, Mich.	$10,241,000*			
Esso Standard Oil Co Baton Rouge, La.	$3,040,000*	New plant and addition to existing facility; 75% complete; est. compl. 1953	H. E. Wiese, Inc.	Refinery gases and cracked distillate
Jefferson Chemical Co Port Neches, Texas	$18,700,000*	Addition to existing facility; construction not started	Own forces	Refinery gases
Gulf Oil Corp Port Arthur, Texas	$15,427,000	New plant; complete	Lummus Co.	Refinery gases
Gulf Oil Corp Texas City, Texas	$585,800	Extension of ethylene pipeline system, and part of $15,427,000 ethylene project; complete	Own forces	
Shell Oil Co. Harris County, Texas	$2,720,000**	New plant; 75% complete; est compl. Dec. 1952	Fluor Corp.	

* Amount covers more than one chemical
** Amount covers provision for expansion of power facilities for benzene, ethylene, and ethyl chloride plant

Table 10—Ethylene Dibromide

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Dow Chemical Co. Midland, Mich.	$200,000			
Dow Chemical Co Midland, Mich.	$70,000			
Dow Chemical Co. Midland, Mich.	$100,000			
Dow Chemical Co. Midland, Mich.	$1,948,000			
Ethyl Dow Co Freeport, Texas	$8,185,000			

Table 11—Ethylene Glycol

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
American Petrochemical Corp Lake Charles, La.	$26,640,000*			
Carbide and Carbon Chemicals Co Institute, W. Va.	$7,507,597*	New plant; in operation		Natural gas
Carbide and Carbon Chemicals Co Whiting, Ind.	$7,582,534*	Addition to existing facility; complete; in operation		Refinery gases
Carbide and Carbon Chemical Co Seadrift, Texas	$66,300,474*	New plant; construction not started; est. compl. 1954		Natural gas
Dow Chemical Co. Freeport, Texas	$19,009,000*			
Hancock Oil Co Long Beach, Calif.	$4,000,000*			
Jefferson Chemical Co Port Neches, Texas	$18,700,000*	Addition to existing facility; construction not started	Own forces	Refinery gases
Jefferson Chemical Co Port Neches, Texas	$2,136,101*	Addition to existing facility; complete; in operation	Own forces	Refinery gases
Mathieson Chemical Co Doe Run, Ky.	$18,980,095*			
Pennsylvania Industrial Chemical Corp Chester, Pa.	$7,640,000*			
Wyandotte Chemicals Corp Wyandotte, Mich.	$6,200,000*	New plant; construction not started		Refinery gases

* Amount covers more than one chemical

Table 12—Ethylene Oxide

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
American Petrochemical Corp Lake Charles, La.	$26,640,000*			

Table 12—Ethylene Oxide (Continued)

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Carbide and Carbon Chemicals Co. Institute, W. Va.	$7,507,597*	New plant; in operation		Natural gas
Carbide and Carbon Chemicals Co. Whiting, Ind.	$7,582,534*	Addition to existing facility; complete; in operation		Refinery gases
Carbide and Carbon Chemicals Co. Seadrift, Texas	$66,300,474*	New plant; construction not started; est. compl. 1954		Natural gas
Dow Chemical Co. Freeport, Texas	$19,009,000*			
Hancock Oil Co. Long Beach, Calif.	$4,000,000*			
Jefferson Chemical Co. Port Neches, Texas	$18,700,000*	Addition to existing facility; construction not started	Own forces	Refinery gases
Jefferson Chemical Co. Port Neches, Texas	$2,136,101*	Addition to existing facility; complete; in operation	Own forces	Refinery gases
Mathieson Chemical Co. Doe Run, Ky.	$18,980,095*			
Wyandotte Chemicals Corp. Wyandotte, Mich.	$6,200,000*	New plant; construction not started		Refinery gases

* Amount covers more than one chemical

Table 13—Formaldehyde

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Allied Chemical & Dye Corp. Hopewell, Va.	$11,900,000*			
Carbide and Carbon Chemicals Co. Marietta, Ohio	$5,740,000	n.a.		
Commercial Solvents Corp. Seattle, Wash.	$723,900	New plant; construction not started		Methanol from natural gas operations
Commercial Solvents Corp. Agnew, Calif.	$450,100*	Addition to existing facility; construction not started		Methanol from natural gas operations
Commercial Solvents Corp. Peoria, Ill.	$585,000	New plant; construction not started		Methanol from natural gas operations
Hercules Powder Co. Mansfield, Mass.	$2,379,904	Application withdrawn		
Heyden Chemical Corp. Fords, N. J.	$280,000			

* Amount covers more than one chemical
n.a.—not available

Table 14—Glycerine

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Shell Chemical Corp. Houston, Texas	$1,514,500	Addition to existing facility; complete	Fluor Corp.	Refinery gases

Table 15—Methyl Alcohol

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Allied Chemical & Dye Corp. Hopewell, Va.	$11,900,000*			
Carbide and Carbon Chemicals Co. Texas City, Texas	$9,040,360*	Addition to existing facility		Refinery and natural gases
Commercial Solvents Corp. Sterlington, La.	$20,458,000*	Addition to existing facility; 50% complete	Ford, Bacon and Davis	Natural gas
Phillips Chemical Co. Texas Gulf Coast	$26,385,500*	New plant; 25% complete; est. compl. Nov. 1953	Hydrocarbon Construction Co. and Chemical Construction Co.	Natural gas
Spencer Chemical Co. Vicksburg, Miss.	$13,758,000			

* Amount covers more than one chemical

Table 16—Methyl Chloride

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Diamond Alkali Co. Houston, Texas	$1,119,000*	New plant; construction not started; est. compl. July 1953		Natural gas
Dow Chemical Co. Freeport, Texas	$3,535,000*			
Dow Chemical Co. Freeport, Texas	$62,100			
Dow Corning Corp. Midland, Mich.	$820,000			

* Amount covers more than one chemical

Table 17—Methylene Chloride

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Diamond Alkali Co. Houston, Texas	$1,119,000*	New plant; construction not started; est. compl. July 1953		Natural gas
Dow Chemical Co. Freeport, Texas	$3,535,000*			
Dow Chemical Co. Pittsburg, Calif.	$670,000			

* Amount covers more than one chemical

Table 18—Nitrogen Materials

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Allied Chemical & Dye Corp. South Point, Ohio	$7,270,000			
Allied Chemical & Dye Corp. La Platte, Nebraska	$24,450,000			
American Cyanamid Co. Avondale, La.	$47,745,000			
Atlantic Refining Co. Philadelphia, Pa.	$3,400,000			
Carbide and Carbon Chemicals Co. Houston, Texas	$681,200	n.a.		
Carbide and Carbon Chemicals Co. Institute, W. Va.	$476,000	New plant; 25% complete		Natural gas
Carbide and Carbon Chemicals Co. Fontana, Calif.	$1,704,082*	n.a.		
Cities Service Refining Corp. (site being considered)	$28,055,800			
Commercial Solvents Corp. Sterlington, La.	$20,458,000*	Addition to existing facility; 50% complete	Ford, Bacon and Davis	Natural gas
Commercial Solvents Corp. Sterlington, La.	$1,326,100*	New plant; nearing completion; in operation	Ford, Bacon and Davis	Natural gas
Cooperative Farm Chemicals Assn. Lawrence, Kansas	$13,818,000*	New plant; construction starts 4th Q. 1952	Foster Wheeler and Girdler Corp.	Natural gas and fuel oil
Dorse & Co. Pryor, Okla.	$17,500,000	New plant; 75% complete; est. compl. 1954	Foster Wheeler	
Delta Chemical Corp. Buras, La.	$8,892,000*	Considered confidential by company		
Diamond Alkali Corp. Houston, Texas	$1,606,000*	Application withdrawn		
Dow Chemical Co. Freeport, Texas	$4,316,800*			
Filtrol Corp. Vernon, Calif.	$3,715,908			
Food Machinery and Chemical Co. South Charleston, W. Va.	$2,503,000*	Project temporarily abandoned		
Grace Chemical Co. Memphis, Tenn.	$15,466,000	New plant; construction just started; est. compl. mid-1954		
Lion Oil Co. Luling, La.	$30,452,000	New plant; less than 25% complete; est. compl. mid-1954	Chemical Corp. and Lummus Co.	Natural gas
Matheson Chemicals Co. Lake Charles, La.	$1,388,238	Addition to existing facility; complete, in operation		
Matheson Chemicals Co. Lake Charles, La.	$411,000	Addition to existing facility; complete, in operation		
Mississippi Chemical Corp. Yazoo City, Miss.	$7,212,446	Addition to existing facility; construction not started	Not selected yet	Natural gas
Mississippi Chemical Corp. Yazoo City, Miss.	$5,704,707	Addition to existing facility; construction not started	Not selected yet	Natural gas
Pacific Chemical Co. Franklin County, Wash.	$5,735,000*			
Phillips Chemical Co. Texas Gulf Coast	$26,385,500	New plant; 25% complete; est. compl. Nov. 1953	Hydrocarbon Construction Co. and Chemical Construction Co.	Natural gas
Phillips Chemical Co. Pasadena, Texas	$1,468,000	Addition to existing facility; 25% complete; est. compl. Dec. 1953	Own forces	Natural gas
San Jacinto Chemical Corp. Houston, Texas	$900,000	Addition to existing facility; construction not started		Natural gas
Shell Chemical Corp. Ventura, Calif.	$6,789,000	New plant; less than 25% complete; est. compl. 3rd Q. 1953	M. W. Kellogg, Gibbs and Hill	Natural gas
Sid Richardson Gasoline Co. Pointe-a-la-Hache, La.	$19,000,000*			
Spencer Chemical Co. Henderson, Ky.	$400,000	New plant; 25% complete	Foster Wheeler and Quaker Valley Constructors	
Spencer Chemical Co. Pittsburg, Kansas	$1,695,000	New plant; 25% complete	Foster Wheeler and Quaker Valley Constructors	
Spencer Chemical Co. Vicksburg, Miss.	$13,758,000*	n.a.		
Union Oil Co. of Calif. Wilmington, Calif.	$5,000,000*	In the engineering stage; construction not begun		
Union Oil Co. of Calif. Wilmington, Calif.	$750,000*	In the engineering stage; construction not begun		
Wyandotte Chemical Corp. Wyandotte, Mich.	$2,624,000*	Application withdrawn		

* Amount covers more than one chemical
—nitrogenous fertilizers
—ammonium sulfate
—anhydrous ammonia
—ammonium nitrate
—urea
n.a.—not available

Table 19—Octyl Alcohols

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Esso Standard Oil Co. Baton Rouge, La.	$326,000	Addition to existing facility; complete, in operation	Own forces	Natural gas and olefins
Esso Standard Oil Co. Baton Rouge, La.	$3,000,000*	Addition to existing facility; 75% complete; est. compl. Nov. 1952	C. F. Braun & Co.	Natural gas and olefins
Gulf Oil Corp. Port Arthur, Texas	$704,756	New plant; near completion	Own forces	Gasoline fractions

Table 19—Octyl Alcohols (Continued)

Standard Oil Co. (Ind.) Wood River, Ill.	$2,552,000	New plant; 25% complete; est. compl. April 1953	M. W. Kellogg	Refinery gases and C. Olefins

* Amount covers more than one chemical
**—octyl alcohol
***—iso-octyl alcohol

Table 20—Pentaerythritol

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Commercial Solvents Corp. Agnew, Calif.	$450,100*	Addition to existing facility; construction not started		Methanol
Heyden Chemical Corp. Garfield, N. J.	$1,707,465			

* Amount covers more than one chemical

Table 21—Perchlorethylene

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Columbia-Southern Chemical Co. Barberton, Ohio	$243,000			
Diamond Alkali Co. Houston, Texas	$2,276,550*	New plant; 75% complete; est. compl. Jan. 1953	Brown & Root, Inc.	Refinery gases
Diamond Alkali Co. (site undecided)	$1,070,000*	New plant; construction not started		Refinery gases
Dow Chemical Co. Freeport, Texas	$4,475,000*	n.a.		
Dow Chemical Co. Freeport, Texas	$3,141,000*	n.a.		
Hooker-Detrex, Inc. Ashtabula, Ohio	$1,491,522*	New plant; complete; in operation	Sanderson and Porter	Acetylene
Hooker-Detrex, Inc. Ashtabula, Ohio	$174,950*	Addition to existing facility; complete; in operation	Sanderson and Porter	Acetylene
Hooker-Detrex, Inc. Tacoma, Wash.	$337,000*	Addition to existing facility; complete; in operation	Roy T. Early	Acetylene
Southern Alkali Corp. Barberton, Ohio	$290,000			
Southern Alkali Corp. Louisville, Ky.	$3,070,000			
Stauffer Chemical Co. Louisville, Ky.	$2,524,000*			

* Amount covers more than one chemical
n.a.—not available

Table 22 Phenol

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Allied Chemical & Dye Corp. Philadelphia, Pa.	$5,200,000			
Carbide and Carbon Chemicals Co. Marietta, Pa.	$6,086,000	n.a.		
Dow Chemical Co. Midland, Mich.	$974,000	n.a.		
Dow Chemical Co. Midland, Mich.	$500,000	n.a.		
Durez Plastics and Chemicals Inc. N. Tonawanda, N. Y.	$6,371,333			
Hercules Powder Co. Paulsboro, N. J.	$8,300,000*	New plant; construction not started	M. W. Kellogg and Welch Construction Co.	Refinery gases
Monsanto Chemical Co. Monsanto, Ill.	$7,030,875			
Reichhold Chemicals Inc. Tuscaloosa, Ala.	$1,375,000			
Standard Oil Co. (Calif.) Richmond, Calif.	$1,760,000			
Standard Oil Co. (Calif.) San Francisco, Calif.	$5,340,000			

* Amount covers more than one chemical
n.a.—not available

Table 23—Styrene

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Carbide and Carbon Chemicals Co. Institute, W. Va.	$1,081,700	Addition to existing facility; 25% complete		Natural gas
Dow Chemical Co. Midland, Mich.	$10,241,000**	n.a.		
Dow Chemical Co. Midland, Mich.	$182,280	n.a.		
Dow Chemical Co. Freeport, Texas	$2,124,180	n.a.		
Dow Chemical Co. Torrance, Calif.	$1,723,000	n.a.		
Dow Chemical Co. Freeport, Texas	$9,400,000	n.a.		
Dow Chemical Co. Midland, Mich.	$3,250,000	n.a.		
Dow Chemical Co. Freeport, Texas	$1,610,000	n.a.		
Goodyear Tire and Rubber Co. Akron, Ohio	$1,762,000	No action has yet been taken		

Petrochemical Expansion

Table 23—Styrene (Continued)

Foster Grant Co. Port Arthur, Texas	$4,284,450			
Koppers Co. Inc. Kobuta, Pa.	$3,691,000	Addition to existing facility; 75% complete; est. compl. 4th Q. 1952	Own forces	Ethylbenzene
Koppers Co. Inc. Kobuta, Pa.	$320,267	Addition to existing facility; complete; in operation	Rochester Coal, Trucking and Contracting Co.	Ethylbenzene
Monsanto Chemical Co. Long Beach, Calif.	$133,320			
Monsanto Chemical Co. Texas City, Texas	$8,600,000			
Pathfinder Chemical Corp. Point Pleasant, W. Va.	$11,496,320			
Pennsylvania Industrial Chemical Corp. Jefferson, Pa.	$3,807,650	New plant; 60% complete; est. compl. mid-1953	Picco	Ethylbenzene from their Chester, Pa., plant, obtained from cracking of crude oil in the manufacture of benzene and ethylene

* Amount covers more than one chemical
*—methyl styrene facility
n.a.—not available

Table 24—Sulfonates, Lube Oil Additives

Company and Location	Amount Certified		Plant Status	Contractor(s)	Raw Materials
Esso Standard Oil Co. Linden, N. J.	$8,529,000*		New plant and an addition to existing facility; 25% complete; est. compl. 1953	Day and Zimmerman, Inc.	Refinery gases
Lubrizol Corp. Wickliffe, Ohio	$548,473		Addition to existing facility; complete; in operation	Own forces	Heavy petroleum oils
Lubrizol Corp. Wickliffe, Ohio	$887,131		Addition to existing facility; complete; in operation	Own forces	Heavy petroleum oils
Monsanto Chemical Co. Monsanto, Ill.	$1,646,000				
Morton Withers Chemical Co. Greensboro, N. C.	$1,780,742		New plant and an addition to existing facility; construction started on addition but not on new plant		
Oronite Chemical Co. Oak Point, La.	$581,200	e	Construction in early stages		
Oronite Chemical Co. Oak Point, La.	$1,593,700		Construction in early stages		
Shell Chemical Corp. Martinez, Calif.	$790,000		Addition to existing facility; complete; in operation	Bechtel Corp.	Refinery gases
Shell Oil Co. Martinez, Calif.	$476,000		Revision of existing facility; complete; in operation	Own forces	Refinery gases
L. Sonneborn Sons Petrolia, Pa.	$750,000				
Standard Oil Co. (Ind.) Wood River, Ill.	$172,650		Addition to existing facility; complete; in operation		Butylenes
Standard Oil Co. (Ind.) Wood River, Ill.	$1,500,000		New plant; 25% complete; est. compl. Dec. 1952		Butylenes

* Amount covers more than one chemical

Table 25—Trichlorethylene

Company and Location	Amount Certified	Plant Status	Contractor(s)	Raw Materials
Diamond Alkali Co. (Site is yet undecided)	$1,070,000*	New plant; construction not started		Refinery gases
Diamond Alkali Co. Houston, Texas	$2,276,550*	New plant; 75% complete; est. compl. Jan. 1953	Brown & Root Inc.	Refinery gases
Hooker-Detrex Inc. Ashtabula, Ohio	$1,491,522*	New plant; complete; in operation	Sanderson and Porter	Acetylene
Hooker-Detrex Inc. Ashtabula, Ohio	$174,950*	Addition to existing facility; complete; in operation	Sanderson and Porter	Acetylene
Hooker-Detrex Inc. Tacoma, Wash.	$337,000*	Addition to existing facility; complete; in operation	Ray T. Early	Acetylene

* Amount covers more than one chemical

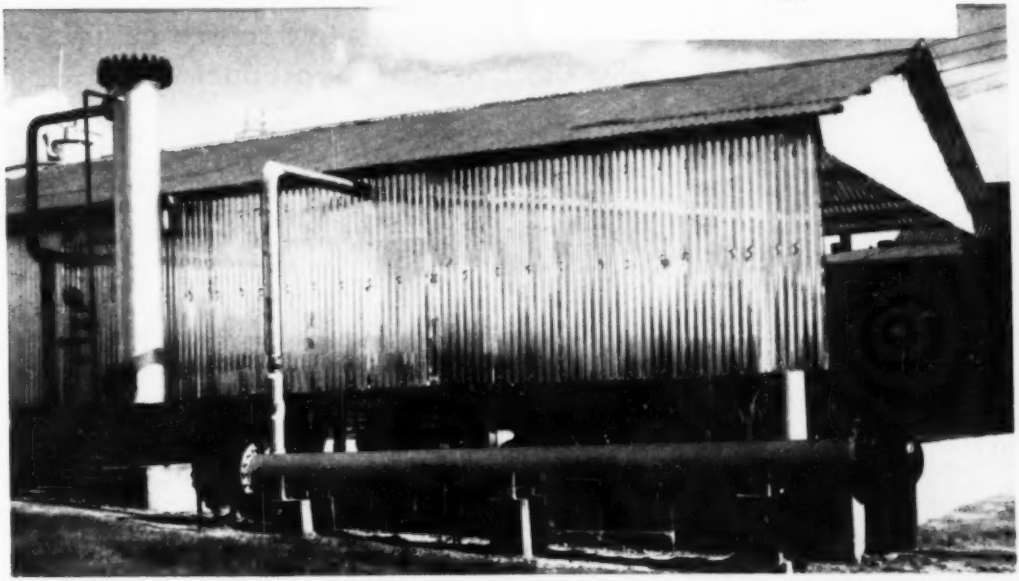
Table 26—Miscellaneous Petrochemicals

Company and Location	Amount Certified	Plant Status	Product	Raw Materials
Celanese Corp. of America Bishop, Texas	$3,485,535	New plant and addition to existing facility; complete	Trioxane and paraformaldehyde	Formaldehyde from company facilities
Diamond Alkali Co. Houston, Texas	$1,119,000*	New plant; construction not started; est. compl. July 1953	Chloroform	Natural gas
Dow Chemical Co. Freeport, Texas	$283,580	Information not available	Propylene glycol	
Gulf Oil Corp. Philadelphia, Pa.	$229,383	Addition to existing facility; 50% complete; est. compl. 1st Q. 1953; work by own forces	Propylene	Refinery gases
Jefferson Chemical Co. Port Neches, Texas	$833,800	Addition to existing facility; complete; in operation; contracting work done by own forces	Nonyl phenol	Propylene polymer
Koppers Co. Inc. Port Arthur, Texas	$4,475,355	New plant; 75% complete; est. compl. Dec. 1953	Ethylbenzene	Ethylene and benzene
Mathieson Chemical Co. Doe Run, Ky.	$18,980,095*		Diethylene glycol, ethylene dichloride, chloroethyl ether	
Texas Eastman Co. Longview, Texas	$6,301,685	New plant; 75% complete; in operation	Butyraldehyde, 2-ethyl hexanol	Natural gas

* Amount covers more than one chemical

How **ALCOA** Activated Alumina dries propane for tank car loading...

Propane dryer, Gregg-Tex Gasoline Corp., Greggton, Texas. Propane enters top of dryer from storage, passes through 8' bed of Alcoa Activated Alumina, discharges from 3" bottom outlet to loading line. Unit dries to *minus* 30° F. dew point at 375 psig. Dehydration is on 6-hour cycles. Reactivation takes 4 hours, with hot residue gas at 14 mcf./hr.



Gregg-Tex can now load *12 tank cars* of propane before any trace of moisture shows on a tester, thanks to Alcoa Activated Alumina. This steady, reliable desiccant dries 120,000 gal. of plant product every day, yet is reactivated, good as new, in four hours.

Here, again, is proof of the day-in-day-out dependability and versatility of Alcoa Activated Alumina. Throughout the petroleum industry you'll find Alcoa Activated Alumina drying liquids, gases, air and gaseous hydrocarbons to *lower* dew points than any other commercial adsorbent.

If you have a drying problem, let us tell you of the economies offered by the oldest, most thoroughly proved desiccant in the petroleum industry. Write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 616-m Gulf Building, Pittsburgh 19, Pa.

Alcoa Chemicals

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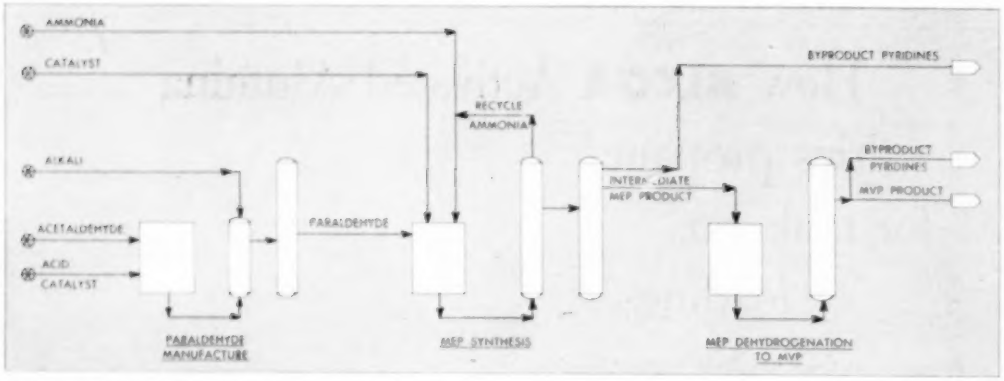
ALUMINAS and FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • TABULAR ALUMINAS • LOW SODA ALUMINAS ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE • GALLIUM



FLOW DIAGRAM of new process developed by Phillips Chemical Co. for synthesis of methyl vinyl pyridine. Raw materials are two common petrochemicals—ammonia and acetaldehyde.

Phillips Synthesize Pyridines

Petrochemical plant opens new source of supply for critically short coal tar byproduct

By J. M. FOLZ, Phillips Chemical Co., and
J. E. MAHAN and D. H. WHITE, Phillips Petroleum Co., Bartlesville, Okla.

THE first commercial plant for the synthesis of methyl vinyl pyridine from petroleum raw materials is in the process of being placed on stream by Phillips Chemical Co. at its Port Adams plant near Pasadena, Texas, on the Houston Ship Channel. The principal raw materials come from natural gas: ammonia, produced by Phillips in West Texas, and acetaldehyde, purchased from another petrochemical plant on the Texas Gulf Coast. The synthesis also is a Phillips development.

The high-purity methyl vinyl pyridine (MVP) to be produced will be used in the manufacture of a new wool-like synthetic fiber. One of the intermediates, methyl ethyl pyridine (MEP), is a starting material for niacin manufacture, a B-complex vitamin. Other pyridines are used in the pharmaceutical field (sulfa drugs and antihistamines), water-proofing of fabrics and synthetic rubber.

Pyridine and its derivatives have been known and used by the laboratory chemist as solvents for many years, and they have been used in a somewhat limited application as industrial solvents. The principal source has been as a byproduct derived from coal tar produced in coke manufacture, a source which was adequate to supply the demand for many years. Since 1943, however, the price has risen steadily from 40¢ to $1.05 per lb., approximately, reflecting the increased demand as a chemical intermediate.(1)

Phillips became interested in pyridine chiefly because the methyl ethyl derivative could be dehydrogenated to MVP, or converted to other products, including niacin. MEP was synthesized from acetaldehyde or paraldehyde and ammonia as early as 1887, but yields were poor and formation of high-boiling pyridines and large amounts of tar complicated the reaction.(2) It was not until Frank and his associates at the University of Illinois developed a method for the Office of Rubber Reserve, RFC, during World War II that reasonable yields were obtained.(3, 4) Frank obtained MEP yields as high as 70% of theoretical by using ammonium acetate as catalyst and a large excess of ammonia over theory.

The Research Division of Phillips Petroleum Co. investigated the Frank reaction further and found how to secure even higher yields through the use of improved catalysts and promoters.

A thorough investigation also was made of the dehydrogenation of MEP to MVP, which was intensified as to both phases as interest developed in the commercial manufacture of the latter. Certain critical steps in the process were carried through the pilot plant stage by Phillips' Chemical Engineering Division at Philtex Experiment Station near Borger, Texas. This work was recently described.(5) The culmination of this work is the present MVP plant at Port Adams, estimated to have cost approximately $3,100,000. It is too early to give a detailed description of the plant at this time but a brief description is in order because of the general interest in this advancement in petrochemical manufacture.

It should be noted that the term "pyridine" as used in this paper usually refers to one of the pyridine derivatives, or a mixture thereof, and not to pyridine itself.

MVP Manufacture

The manufacturing operations at Adams Terminal utilize acetaldehyde and ammonia as raw materials. The acetaldehyde is converted into paraldehyde as a preliminary step in the synthesis of methyl ethyl pyridine.

As shown on the simplified flow diagram above, the paraldehyde for the MEP synthesis step is prepared by the trimerization of three moles of acetaldehyde to one mole of paraldehyde in the presence of a small amount of sulfuric acid catalyst:

$$3CH_3CHO \xrightarrow[\text{Catalyst}]{H_2SO_4} (CH_3CHO)_3$$

Make-up acetaldehyde and sulfuric acid are fed continuously into the polymerization reactor, the exothermic heat of reaction being removed by cooling water in an external heat exchanger. The acid catalyst is neutralized and the paraldehyde is purified by fractionation prior to the MEP synthesis step.

The MEP synthesis consists of a liquid phase reaction of paraldehyde

FIRST COMMERCIAL UNIT for pyridine synthesis, recently completed by Phillips at its Port Adams plant near Pasadena, Texas. Distillation facilities are shown at right, reaction section at left

with ammonia. The main reaction is as follows:

$$3\,(CH_3CHO) + NH_3 \rightarrow$$

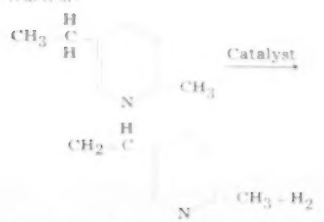
$$+ 3H_2O$$

In addition to the main product, a certain amount of 2-picoline, 4-picoline, and heavy pyridine by-products are formed. An excess of ammonia is maintained over the theoretical amount required.

The reaction effluent is passed to separation equipment, the excess ammonia being recycled to synthesis. Various major pyridine fractions are recovered in technical grade purity, including a lower-boiling by-products cut, a slops cut for rerun, an MEP cut, another slops cut for rerun, and a bottoms product of higher boiling pyridines. The MEP cut is sent to surge storage prior to its use as feed in the MVP section of the plant.

The intermediate product (MEP) is a clear liquid with a boiling point range at 760 mm. Hg pressure of 345 to 356° F. As mentioned previously, there are many end uses for this intermediate product other than that being employed by Phillips.

The main dehydrogenation reaction can be illustrated by the following reaction:



In addition to the main product of 2-methyl-5-vinyl-pyridine, a certain amount of pyridine, as such, 2-picoline, 3-picoline, 3-ethyl-pyridine, lutidine (2,5-dimethyl-pyridine), and 3-vinylpyridine by-products are produced.

MVP is recovered as a final product. It can be shipped in drums, tank trucks, or tank cars. It is recommended that vapor tight containers be used due to the characteristic pyridine odor.

Materials of Construction

The manufacture and handling of pyridines has its special materials of construction requirements and the deviation from the usual petroleum handling conditions are believed to be of general interest. Through special mechanical design it has been possible to use carbon steel almost exclusively in the construction of the process equipment.

Since pyridine homologs and ammonia react with copper, the use of Admiralty was not possible in heat exchanger tubes as is so common with water cooler exchangers in petroleum processing. Stainless steel tubes are satisfactory for the prevention of corrosion; however, by specifying a corrosion allowance, carbon steel tubes were installed after giving consideration to the over-all economics of water conditioning, availability, and delivery of the various types of steels.

For the pumps in vacuum service, mechanical seals have been utilized to prevent air leakage into the vacuum system and to prevent undue leakage of the highly solvent pyridines.

Analytical Control

Analytical control to be used consists of two classes: (1) rapid approximate analyses to provide information required for maintenance of control over the processing operations and (2) precision analyses on finished products and on samples of process streams to determine, respectively, the quality of finished products and the efficiency of each unit processing operation.

Methods used in Item 1 for rapid approximate analyses are often basically similar to the analyses of Item 2 except that some simplifying assumptions are often made. The technique used is not quite so rigid as procedures used on samples of the second classification. An infrared spectrophotometer is used quite extensively since the instrument permits rapid analyses with a minimum of labor.

For pilot plant studies the mass spectrometer has also been quite extensively used in routine analyses of the process streams as sample preparation is not required (such as the removal of water), as it generally is with most alternate procedures of analyses. Straight chemical analyses, unsat type of analyses, and colorimetric methods constitute a major share of the analytical requirements in current operations.

Some of the specification tests are quite common to petroleum processing, such as the Gardner test for color specification. Other tests, however, require a high degree of precision, such as the freezing point determination of purity. The freezing point is determined in a modified procedure in accordance with ASTM Method D-1015-49T.

At present all samples are taken and all analyses are run by a central laboratory staff. As operations proceed, development of qualitative or rough quantitative tests will be specified by use by the operating group to aid in the control of the unit process operations.

Acknowledgement

The authors wish to acknowledge the fact that many fellow workers were involved in obtaining the data and preparing the design and also to thank the Phillips Chemical Co. and Phillips Petroleum Co. for permission to publish this paper.

Credit

This article is adapted from the paper "Methyl Vinyl Pyridine Manufacture" which the authors presented at the Oklahoma State Meeting of the American Institute of Chemical Engineers, Tulsa, Oct. 31, 1952.

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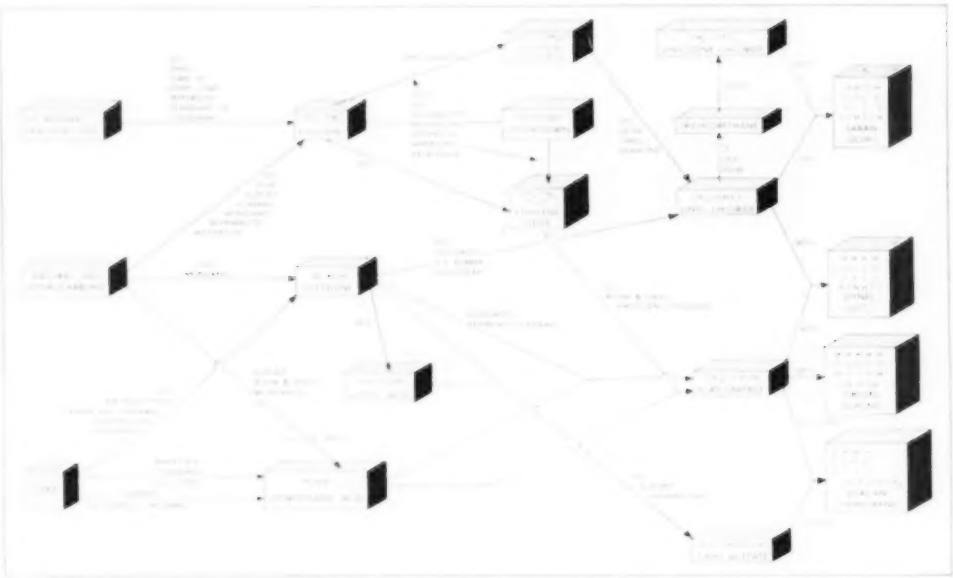


ALIPHATIC BUILDING BLOCKS FOR

Petrochemical Textiles

Part 2—The Monomers

By PETER W. SHERWOOD
Chemical Engineer, New York

THE outlook for synthetic textiles from petroleum sources was considered in Part 1 of this series of articles.* We have also taken a look at the principal processes available for the production of organic raw materials from which the aliphatic building blocks for petrochemical textiles are derived.

We must now turn our attention to the second essential step in this segment of the industry: conversion of the primary raw materials—ethylene, acetylene, and hydrogen cyanide—to the aliphatic monomers which may be polymerized (or copolymerized with other monomers) into fibers.

Ethylene Oxide Production

The significance of ethylene oxide in the field of synthetic fiber production was clearly demonstrated in the chart shown in Part 1 of this series. With hydrocyanic acid, it is the route to acrylonitrile, in turn a source for Dynel, Acrilan, and Orlon. In addition, this chemical compound figures significantly in the production of Dacron, which is fundamentally a copolymer of terephthalic acid and ethylene glycol.

Two commercially successful routes are available for the production of ethylene oxide: one via chlorination of ethylene to the chlorohydrin, and the other via oxidation of ethylene directly in the presence of silver catalyst:

$$CH_2{:}CH_2 + H_2O + Cl_2 \rightarrow ClCH_2CH_2OH \rightarrow CH_2CH_2O \quad (8)$$

$$CH_2{:}CH_2 + O_2 \rightarrow CH_2CH_2O \quad (9)$$

Fully 69% of the 1952 ethylene oxide production of 710,000,000 lbs. is slated to go into the production of ethylene glycol. During the same year, acrylonitrile will only consume about 7% of the nation's ethylene oxide output. However, a striking feature of recent years has been the relative decline of glycol as primary market for ethylene oxide, and the rapid rise in importance of other outlets for this important chemical. Thus, by 1962, ethylene glycol is expected to consume more than 58% of the ethylene production. Acrylonitrile, on the other hand, is forecasted to account for 17-20% of the total anticipated output of 1,116,000,000 lbs.

Most of the tremendous activity in this field has been concentrated in the chlorohydrin route, process (8). Although successful direct oxidation of ethylene dates back to the early thirties, by 1951 there had been only two plants in the United States which operated according to this principle. During the last year or so, active interest in direct oxidation of ethylene has once again been revived. At this writing, there are at least three plants under construction which are based on some version of this process.

The choice between chlorohydrination and direct oxidation as the preferred method for producing ethylene oxide is intimately tied to chlorine economics. The former process consumes approximately two pounds chlorine per pound of primary product. The acute prevailing chlorine shortage of recent years is certain to exert important influences toward further development and acceptance of the direct oxidation method.

Ethylene Oxide via Chlorohydrin

The chlorohydrination reaction, involving ethylene, chlorine and water, is carried out in vertical, sectional, packed towers. Chlorine is fed into the bottom of the flooded tower while

* "Aliphatic Building Blocks for Petrochemical Textiles," P. W. Sherwood, PETROLEUM PROCESSING, November 1952, pp. 1653-1658.

ethylene is introduced at a higher level. It is essential that these two feed lines be placed at a sufficient distance to permit the reaction, $H_2O + Cl_2 \rightarrow HCl + HOCl$ to be completed before any ethylene is introduced into the reaction medium.

Such an arrangement is essential to minimize the formation of by-product dichloroethane. In some plants, this conclusion is taken to the extreme of providing a separate mixing tower for chlorine and water followed by an ethylene reaction tower.

Water is continuously introduced into the bottom of the chlorohydrination reactor. Lean gas is continuously withdrawn from the top of the tower after passage through a water spray, and is cleaned in a caustic water scrubbing tower, after which a portion of it is recycled. The product of the reaction is removed at the top of the tower as a 4.5 to 5% solution of ethylene chlorohydrin in water.

The reaction is carried out at 120° F, a temperature which is spontaneously developed from cold feed by the exothermic heat of reaction. An excess of ethylene must be carefully maintained at all times, and the top gas contains some 15-20% ethylene. Not all of this is lost, since a considerable portion of the top gas is recycled. An excess of chlorine must be scrupulously avoided, partly because it tends to decrease the yield, and partly because it creates a serious corrosion problem in the gas lines.

The purity of the ethylene feed stream is not particularly critical from a chemical point of view. Mixed with recycle, ethylene enters the reaction tower at a concentration of 70-75%, but lower concentrations have been used successfully, though with concomitant reduction in capacity.

The presence of higher olefins is objectionable, because they will form the corresponding chlorohydrin, thus raising chlorine consumption and compounding the problem of product purification. Hydrogen is to be held at very small concentrations because its presence introduces a very real explosion hazard.

The overflow from the chlorohydrination reactor is taken to the hydrolysis where the dilute ethylene chlorohydrin is converted to ethylene oxide in the presence of lime.

Lime is generally employed as an aqueous slurry containing 10 per cent CaO. To prevent corrosion problems at a later stage in the process, the absence of ammonia must be ensured. Certain other impurities in lime, notably magnesia, tend to promote the formation of acetaldehyde, and must therefore be avoided.

A slight excess of lime above theoretical requirements is maintained in the hydrolysis reactor in order to ensure maximum conversion to ethylene oxide, and to prevent the occurrence of a corrosive condition.

Table 3—Typical Materials and Energy Balance in Production of Ethylene Oxide

A: Materials and Power Consumed per Net Ton Ethylene Oxide	
Ethylene	0.91 tons
Chlorine	2.16 tons
Milk of Lime (100% CaO)	2.03 tons
Sodium Hydroxide	0.036 tons
Steam	10.9 tons
Electricity	143.0 KWH
Water	73,000 gals
Nitrogen	350 cu. ft.
Compressed Air	100 cu. ft.
B: By-products per Net Ton Ethylene Oxide	
Dichloroethane	0.16 tons
Chloro-ether tar residue	0.09 tons

The equipment for the hydrolysis step consists of vertical or horizontal cylindrical units, provided with internal baffles to prevent the mixing of feed and "make" streams. Internal agitation may be provided, e.g. by the introduction of live steam.

In a horizontal unit, the mixed feed enters at one side of the reactor where it is soon heated to 205° F by live steam. In the early stages of the reaction, the temperature is maintained at this level in order to prevent excessively fast development and evolution of ethylene oxide which may result in operating difficulties due to frothing and splashing. Eventually, the temperature is allowed to rise to 215° F to complete the hydrolysis. Normal hold-up time in the reactor is 15 to 30 minutes.

The spent slurry leaving the reactor is waste product and is discarded. Its disposal presents the usual difficulties associated with calcium chloride solutions. It still contains some ethylene oxide which has failed to volatilize and accounts for most of the yield losses in the hydrolysis stage.

Volatilized ethylene chlorohydrin is condensed in a dephlegmator surmounting the reactor, and flows back into the converter phase. By operating this partial condenser at approximately 185° F, ethylene oxide and byproduct ethylene dichloride (dichloroethane) will pass through it.

A typical analysis of this gaseous product stream is 40% ethylene oxide, 4-5% dichloroethane, some acetaldehyde and ethylene chlorohydrin. The remainder is principally water. This composition is, of course, subject to wide variations, depending on the dephlegmating efficiency of the cooler and the exact operating conditions inside the reactor.

The gaseous product is partly condensed by cooling to 80-85° F. The condensate is separated from the residual gas phase. Both phases are introduced into the primary distillation column at two different plates.

The primary distillation column is operated for the separation of ethylene oxide from water. To avoid hydrolysis and side reactions of ethylene oxide at this stage, the column is generally operated at a head pressure of 20-30 mm. Hg. abs. Top temperature is maintained at 33-35° F.

Ethylene oxide, removed as overhead product, is subjected to a second distillation for purification purposes. Again, vacuum operation is common practice. The ethylene oxide produced in the course of this distillation analyzes 98-99% ethylene oxide. For applications in which the residual 0.5% acetaldehyde proves objectionable, a third distillation may become necessary, or chemical methods of purification may be utilized.

The bottoms of the primary still are rich in dichloroethane. This byproduct, which is itself an important raw material in the production of vinyl chloride (see below) is recovered and purified.

Overall process yield in the production of ethylene oxide via ethylene chlorohydrin is about 70%. As a byproduct, some 5-9% dichloroethane can be recovered. A typical materials and energy balance is given in Table 3[14].

Direct Air Oxidation

At this date, the direct oxidation of ethylene to ethylene oxide is still severely hampered by the relatively low yields and a first investment cost which greatly exceeds the capital requirements for a plant following the indirect route described above. As will be seen later, these two factors are significantly related.

The process, in all its successful variations made known to date, is based on the use of a silver catalyst, generally supported on some type of aluminua carrier. Detail methods by which a number of the more important catalysts of this type can be produced have been discussed by the author elsewhere[15].

It is customary to mix ethylene with a large excess of air, enough to maintain the hydrocarbon concentration below the explosive limit. The gas mixture is preheated in exchange with the product stream and is introduced into the catalytic reactor. Conversion temperature is carefully controlled at the optimum conversion point (between 400 and 600° F, depending on catalyst preparation and age).

The ethylene conversion per pass is

TYPICAL ETHYLENE OXIDE units at the Institute, W. Va., plant of Carbide and Carbon Chemicals Co.

about 40-45%. Reaction efficiency is in the range of 50% of theory. However, since a portion of the unconverted ethylene must be bled from the system, the overall yield obtained commercially is about 50%. (Note that some catalyst formulations will in the laboratory achieve yields up to 65%. In some instances which have come to this author's attention, the use of such catalysts was defeated by insufficient physical strength for commercial purposes).

A noteworthy feature of the silver-catalyzed reaction is the finding that there are substantially no byproducts other than carbon dioxide (and water). Acetaldehyde, the only organic impurity present, is formed at reaction temperatures in only very small quantities (0.2% of the ethylene oxide produced).

Where ethylene oxide is the desired final product, it is removed from the reactor effluent gases by absorption in water. A part of the scrubbed gases is recycled. The remainder is bled from the system.

Ethylene purity should be as high as feasible (say 97-98%). The presence of other hydrocarbons or of hydrogen is objectionable because their combustion will contribute to the total heat removal problem without doing any useful work. The importance of this will be realized if it is considered that the oxidation of one pound-mole ethylene to ethylene oxide will liberate 50,000 Btu, while oxidation of the same amount of ethylene to carbon dioxide and water will result in the evolution of 570,000 Btu.

The highly exothermic heat of this reaction influences reactor design and first plant cost considerably. Obviously, if the useful yield of the reaction can be boosted significantly by the repression of carbon dioxide formation, the amount of heat exchanger surface can be greatly reduced. Thus, a conversion efficiency of 70% of theory would result in the evolution of 6500 Btu/lb. ethylene oxide. At the presently attainable efficiencies of 55%, fully 11,500 Btu are generated for every pound.

To cope with this high heat of reaction, tubular reactors of the type largely employed in fixed-bed catalytic cracking are used. Alternate schemes, such as fluidized-catalyst technique, have been mentioned in the patent literature but have not, to the author's knowledge, achieved commercial status.

Corrosion-resistant materials are essential for the catalyst-containing tubes. The occurrence of rust in the presence of the reaction phase would catalyze the formation of formaldehyde and formic acid and the complete combustion of ethylene.

The ratio of air to ethylene has a very pronounced effect on the conversion. For good yields it is necessary to use a high air:ethylene ratio. The yield rises rapidly until the ratio of reactants becomes about 7-8. No significant improvement is realized by raising the amount of excess air above this point. The permissible ethylene concentration is therefore actually set by the explosive limit.

To obtain a higher ethylene oxide concentration in the "make" stream, while maintaining the ethylene content at any point in the reactor below 3%, a useful scheme is to operate two or more reactor units in succession. Sufficient ethylene is bled into the gas stream between stages to restore the permissible ethylene concentration limit at the entrance to the next converter.

One approach to boosting the reaction yield involves the use of "anti-catalysts" which are intended to suppress the formation of carbon dioxide. A process announced by the National Research Council of Canada makes use of such an anti-catalyst (possibly dichloroethane) over a modified silver catalyst at rigorously controlled temperatures. It is reported that this process can successfully handle refinery gases containing as little as 10% ethylene by suppressing the oxidation of paraffinic hydrocarbons in the feedstream. According to McBee[18], dichloroethane does indeed have a favorable effect on ethylene oxide yield, if present in small quantities. Excess dichloroethane results in catalyst poisoning.

Production of Acrylonitrile

Two fundamental schemes are available for the production of acrylonitrile from petrochemical sources: one from ethylene oxide and hydrocyanic acid via ethylene cyanhydrin, the other direct from acetylene and hydrocyanic acid:

$$CH_2CH_2O + HCN \rightarrow HOCH_2CH_2CN \rightarrow CH_2{:}CHCN \quad (10)$$

$$CHCH + HCN \rightarrow CH_2{:}CHCN \quad (11)$$

Acrylonitrile from Ethylene Oxide

This is the classical route for the production of acrylonitrile in the United States. As late as 1951 when American Cyanamid was the only active producer of acrylonitrile the competitive acetylene process had not yet entered the American scene. Ethylene oxide served as raw material at American Cyanamid's plant as well as in the acrylonitrile installations which were operated during the war by Rohm and Haas and by du Pont.

At operation conditions encountered in the petroleum-producing areas (e.g. in the Southwest), the economics of the more recent acetylene process appear more favorable. Construction activities of the last two years have, however, not confirmed the prophecies of doom for the ethylene oxide-to-acrylonitrile route (which has been selected for one plant of Carbide and Carbon Chemicals Co. as well as for one other installation). The process

continues to be of interest in integrated plants where ethylene oxide consumption for this function represents only a small portion of the total ethylene oxide output (i.e. where the incremental cost of additional ethylene oxide production is low). Beyond this, consideration must be given to the lower capital cost involved in an acrylonitrile plant using ethylene oxide as raw material as compared to an acetylene-to-acrylonitrile installation.

The first step, production of ethylene cyanhydrin from ethylene oxide, has been practiced on a batch basis although the literature has also vaguely referred to continuous processing. The following description is for a typical instance[17] where the operation is carried out by batch conversion.

In this operation, equimolar portions of ethylene oxide and liquid hydrocyanic acid are introduced gradually into a reactor containing an aqueous solution of diethylamine and sodium hydroxide (which serve as catalysts). The time of addition is ten hours. During this period the temperature is maintained at 130-140° F and the mixture is vigorously agitated.

After the addition has been completed, the temperature is maintained at 140° F for five hours more. The product is then neutralized by the addition of acetic acid and finally sulfuric acid, and is discharged to a storage tank. The total reaction cycle time is sixteen hours.

The reaction product is fed to a continuous vacuum still where moisture is removed. The overhead from this still contains a small amount of unreacted hydrocyanic acid which may be recovered or converted to saleable sodium cyanide.

The bottoms leaving the still contain ethylene cyanhydrin, water, and residual matter. Most of the residue is filtered off leaving a product containing 90% ethylene cyanhydrin.

The conversion of ethylene cyanhydrin to acrylonitrile may be carried out in the vapor phase or in the liquid phase. Alumina or related catalysts serve for vapor-phase dehydration but the commercial development of this technique has had to overcome difficulties due to rapid catalyst fouling.

Typical of vapor-phase processes for the dehydration of ethylene cyanhydrin is a Rohm and Haas patent[18], according to which the reaction is carried out over alumina or thoria catalysts under reduced pressure and at 570-930° F. Liquid hourly space velocity is of the order of 2. The catalyst must be regenerated periodically by passing air over it at 660-750° F. While the initial yield of acrylonitrile is said to be as high as 94% of theory, this efficiency drops with advancing age of the catalyst. An average yield of 90% is claimed.

Dehydration in the liquid phase is carried out in the presence of magnesium carbonate or bauxite suspended in a heavy oil. At one acrylonitrile plant, ethylene cyanhydrin and its polymerization products have served as suspension medium. Fresh ethylene cyanhydrin and catalyst are continuously fed into the reaction mass. Volatile acrylonitrile and water are removed overhead. The reaction is continued with the same oily phase in the kettle until its increased consistency dictates a change of media. In this somewhat primitive system, the overall yield of acrylonitrile was slightly below 80% of theory. Improved methods substitute alternate oils as carrier medium (e.g. diphenyl). Yields as high as 90% of theory have been reported for this system.

Crude acrylonitrile is separated from water. Dissolved acrylonitrile is recovered from the aqueous layer by distillation. The combined make of acrylonitrile is finally purified by distillation in the presence of a polymerization inhibitor (e.g. methylene blue).

In the manufacture of acrylonitrile from ethylene oxide and hydrocyanic acid, using vapor phase dehydration, it is estimated that overall raw materials consumption is slightly above one pound ethylene oxide and about 0.65 pounds hydrocyanic acid per pound of product.

Acrylonitrile from Acetylene

The origins of this synthesis go back to the work of America's Nieuwland and associates. The process was, however, first placed into commercial operation in wartime Germany, and is now a newcomer to large-scale production in the United States.

The reaction is carried out in the presence of a liquid catalyst. Typical composition is an aqueous solution of equimolar quantities of ammonium chloride and cuprous chloride (a mixture of 1 part sodium chloride and 4 parts potassium chloride may be substituted for ammonium chloride). Salt concentration is controlled to a specific gravity of 1.55-1.6. No advantage is gained by raising the concentration beyond this point while operating difficulties due to crystallization may occur at greater degrees of saturation.

pH control of the catalyst solution is of signal importance. Small amounts of byproduct monovinyl chloride are continuously formed and the resultant hydrogen chloride depletion must be made up periodically.

A temperature of 195° F is considered optimum. At lower levels, acrylonitrile output is excessively reduced, while control of catalyst composition becomes difficult due to the high vapor pressures above 195° F. The operating pressure is preferably held at 15 psig, the maximum compatible with safe operation. Higher pressures are made feasible by diluting the acetylene stream with nitrogen, a method which is claimed to lengthen the active catalyst life.

The optimum ratio of reactants entering the converter is in the range of 10 moles acetylene: 1 mole hydrogen cyanide. Almost complete conversion of the hydrogen cyanide is expected and the concentration of this acid in the crude reactor product serves as criterion for the control of the operation.

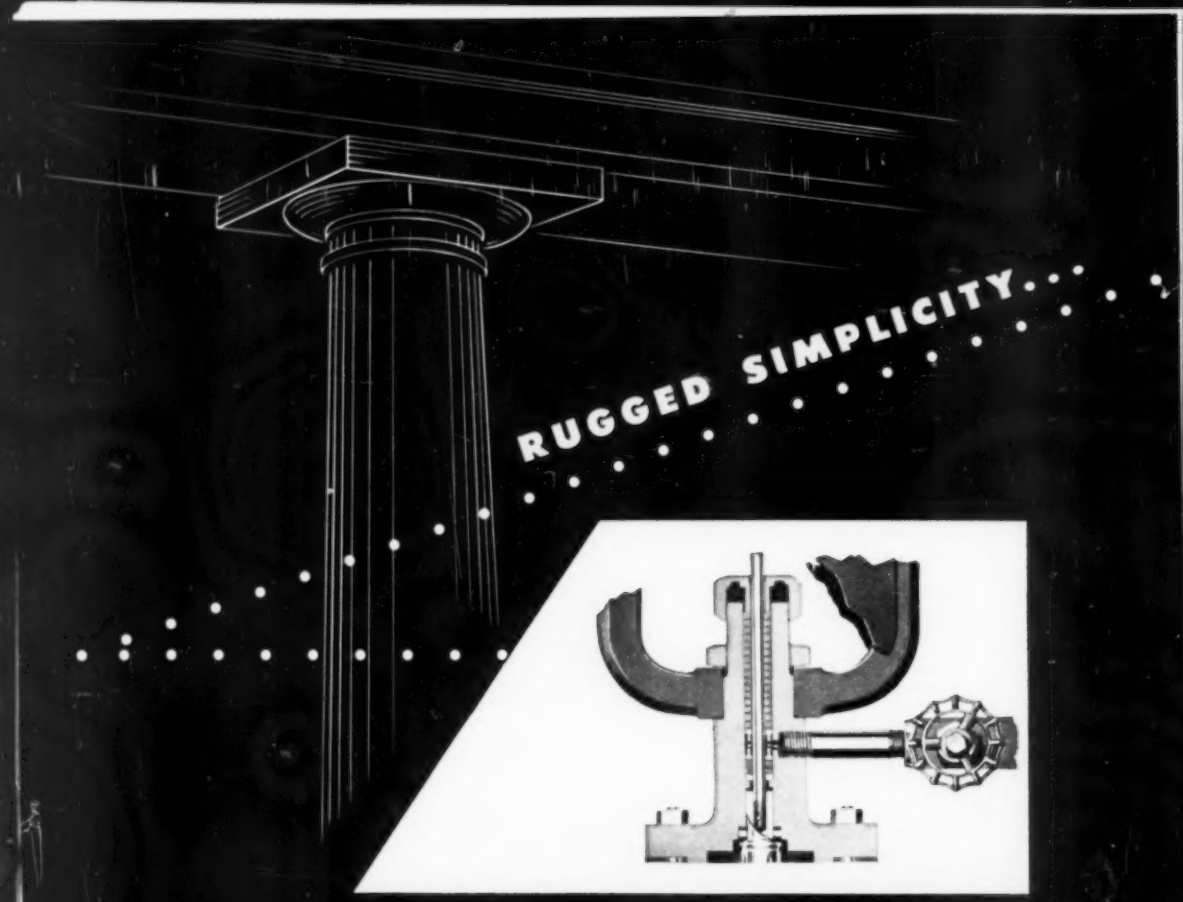
At these conditions, the output of acrylonitrile will be, on the average, 75 lbs./hr. acrylonitrile per 100 cu.ft. catalyst (conversion rate with fresh catalyst is 50% above this value). Catalyst life ranges from a normal four weeks to a reported six weeks with an unusually pure acetylene feed. In actual practice, make-up catalyst is supplied at frequent intervals while an equal volume of solution is withdrawn from the reactor. Acrylonitrile yield is 80-85% based on acetylene and 90-95% based on hydrocyanic acid.

The gas leaving the reactor is cooled to 65-75° F on its way to a water scrubber in which a 1-2% acrylonitrile solution is obtained. The excess acetylene leaving the absorber carries with it substantial amounts of vinyl acetylene and divinyl acetylene along with some other byproducts. Attempts to remove these materials from the acetylene stream, which is recycled to the reactor, have so far been defeated by the explosive characteristics of concentrated vinyl acetylene. In common practice, these byproducts are therefore carried back to the reactor where they undergo further condensation and polymerization reactions and eventually show up as catalyst tar.

The dilute aqueous acrylonitrile solution is stripped by means of live steam in a Rasching ring-packed tower operated at atmospheric pressure. The bottoms of this tower must be depleted of acrylonitrile because their foaming tendency prevents their reuse in the absorber column. The overhead from the stripper is condensed and separated into layers. The aqueous layer is recycled to the stripper column.

The crude acrylonitrile layer contains approximately 80% acrylonitrile. Aside from water, the principal impurities are acetaldehyde, monovinyl acetylene, cyanobutadiene, and lactonitrile, along with a host of secondary compounds in small quantities. Final purification is achieved in a series of distillation steps.

A typical refining scheme involves a primary column for the overhead removal of acetaldehyde and water. In this distillation, water is removed in



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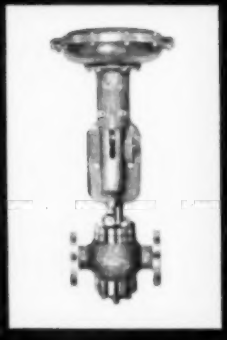

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azeotropic mixture with acrylonitrile at an intermediate point of the column. Upon condensation, the make is separated into two layers. The organic layer is returned to the distillation column while the aqueous layer is cycled to the crude monomer stripper mentioned above.

A secondary distillation column will separate substantially pure acrylonitrile from high-boilers. This column must be operated at partial vacuum to prevent the formation of volatile HCN by decomposition of lactonitrile.

A third column serves to separate residual acrylonitrile from the bottoms of the secondary still. The overhead is contaminated with hydrocyanic acid, etc. and must be returned to the primary (acetaldehyde) still.

The presence of divinyl acetylene in the refined (99+ %) acrylonitrile from the secondary still stands in the way of successful execution of a number of polymerization reactions. A preferred method for removal of this impurity is batch steam distillation of a water-acrylonitrile mixture. The first small overhead fraction contains the bulk of the bothersome divinyl acetylene. The method is thermally inefficient and consequently costly. Alternate methods which have been investigated include selective chlorination of divinyl acetylene followed by redistillation.

The purification system here described has proved its effectiveness in commercial practice. Numerous alternate schemes have been described — some involving only two columns and promising high thermal efficiency and substantial freedom from divinyl acetylene in the product. Some of these proposed methods have merit but their detailed consideration here would lead too far afield.

Production of Vinyl Chloride

In the production of this monomer, the competitive standing of ethylene and acetylene chemistry once again finds expression. Two basically different processes have found commercial application. The following fundamental reactions are involved:

$$CH_2{:}CH_2 \xrightarrow{Cl_2} Cl\text{-}CH_2\text{-}CH_2\text{-}Cl \xrightarrow{HCl} CH_2{:}CHCl \qquad (12)$$

$$CHCH + HCl \rightarrow CH_2{:}CH\text{-}Cl \qquad (13)$$

Vinyl Chloride via Dichloroethane

Dichloroethane, a by-product in the production of ethylene oxide (q.v.) may serve as intermediate in the synthesis of vinyl chloride. Production of dichloroethane for the express purpose of subsequent dehydrohalogenation is practiced by at least three plants. This indirect production route consumes approximately 1.4 lbs. chlorine per lb. vinyl chloride and raises a significant problem for the disposal of by-product hydrogen chloride unless a natural outlet exists for it in the vicinity of the plant site. The process has the advantage of yielding a high-grade monomer with minimum purification difficulties.

Results have become available on pilot-plant operations at Imuijden[19] which served as basis for the commercial vinyl chloride plant erected by Royal Shell at Rotterdam, Holland.

At this plant, dichloroethane is produced by the direct chlorination of ethylene in the presence of $FeCl_3$ catalyst suspended in liquid dichloroethane. Reaction conditions are 115° F and 75 psig. Due to the exothermic nature of the reaction (70,000 Btu/lb-mole), intimate mixing must be provided in the reactor to prevent local overheating. The conversion of ethylene is 98%. Overall yield of dichloroethane is reported to be 95% of theory.

The product is separated from gaseous components. The liquid phase is then carefully water-washed to ensure the complete destruction of residual catalyst. To prevent corrosion in the subsequent step, the product must finally be freed of water by azeotropic distillation.

Of the three routes available for the dehydrohalogenation of dichloroethane, the catalytic vapor phase technique alone is employed commercially. Alternate systems include thermal dehydrohalogenation (which shows lower yields) and conversion by the chemical interaction with caustic (resulting in high raw material costs).

At Shell's Rotterdam plant, the dehydrohalogenation of dichloroethane is carried out at 900-930° F and 20-30 psig. The catalyst has not been disclosed but is probably a modified pumice or kaolin. To minimize secondary reactions, the conversion of dichloroethane is held at or below 70% per pass. The overall yield is stated to be nearly theory. (In a laboratory study of the process by Rossi[20], 90% yields were obtained with pumice at the optimum temperature of 1160° F).

The reactor make gas is rapidly cooled to avoid the continuance of side-reactions. After separation of entrained tar from the gas phase, the two main products (vinyl chloride and hydrogen chloride) are separated by absorbing the organic compound in dichloroethane. The scrubber column is operated at substantially ambient temperature. Absence of vinyl chloride and dichloroethane in the lean scrubber gases is further ensured by cooling to 5° F in an overhead heat exchanger.

Unless byproduct hydrogen chloride finds immediate use at the plant site (which is not the case for Shell's plant), it is necessary to absorb it in water for subsequent muriatic acid sales. To satisfy commercial specifications, further removal of organic matter must be provided by secondary scrubbing and, if necessary, even by charcoal treatment of the acid make.

The rich liquor effluent leaving the scrubber column is fractionated at 75 psig for the overhead recovery of crude vinyl chloride which is subsequently subjected to a refining distillation. In this step, stainless steel equipment is employed for the rigorous exclusion of iron contamination. The still residue in this final purification step is predominantly dichloroethylene.

The stream of dichloroethane, recovered in the bottoms of the primary fractionation still, is recycled in part to the HCl-vinyl chloride scrubber. The remainder is subjected to a purifying distillation in which dichloroethane is recovered in sufficiently high quality (99.9%) to permit recycling to the reactor stage.

Vinyl Chloride from Acetylene

The reaction of acetylene and hydrogen chloride is universally carried out in the presence of a mercuric chloride catalyst on a suitable carrier. Active charcoal is most common for this purpose but equally good activity has been reported[21] for pumice and for alumina gel. The latter carrier exhibits, moreover, a retention power for volatile mercuric chloride which equals that of activated carbon.

A favored catalyst contains 10% mercuric chloride. However, at least one instance has been reported[22] of a commercial catalyst containing only 1% mercuric chloride and 20-30% barium chloride.

Both acetylene and hydrogen chloride must be highly purified and dried before they are mixed at a point preceding the reactor proper. A slight excess (say 10%) of hydrogen chloride is maintained to minimize acetylene losses to condensation reactions. Feed composition in recycle operation is roughly on an equimolar basis.

The reactors must cope with the evolution of 670 Btu/lb. vinyl chloride formed. Tubular reactors are employed with the catalyst either inside the tubes or arranged outside them. The cooling medium is either a suitable heat transfer oil circulated through external heat exchangers or circulating water at its boiling point. In the latter case, the temperature is adjusted by control of the pressure on the cooling medium.

The mass of the catalyst is initially held at 212° F. As the activity of the catalyst decreases, the average operating temperature is boosted up to a maximum of 355° F. In any case, a hot spot will be observed in the cata-

lyst bed which travels in the direction of the gas flow (usually downward). Care is taken that this hot spot will not exceed 425° F. If necessary by cutting back the rate of reactants fed to the system. The control may be further facilitated by introducing inert gas (say up to 30% nitrogen) into the reactor stream. If properly protected, a catalyst life of six months may be expected.

Very high conversion, and yields of about 82-85% (on acetylene) can be achieved in a single pass. Better yields are obtained by limiting the per-pass conversion to lower values (say 25%) and recycling the unconverted acetylene-hydrogen chloride mixture. In recycle operation, overall acetylene consumption as low as 45.3 lbs. per 100 lbs. vinyl chloride has been reported (92.5% yield). Yield in the reaction stage proper is up to 96% of theory.

In a single-pass operation, excess hydrogen chloride may be removed from the product gases by water and caustic scrubbing. The neutralized gas is dried and liquefied. The condensate is fractionated, first for the removal of dissolved gases and light boilers, and finally for the purification of vinyl chloride.

In recycle operation, vinyl chloride is separated from the much larger amounts of unconverted acetylene and hydrogen chloride by absorption in a suitable solvent (dichloroethane, trichloroethylene, etc.). The absorption is carried out at reduced temperatures (around 20-35° F). Vinyl chloride is recovered from the solvent by a primary distillation and is finally purified by fractionation.

Production of Vinylidene Chloride

The commercial synthesis of vinylidene chloride involves the rechlorination of vinyl chloride followed by dehydrohalogenation.

$$CH_2{:}CHCl + Cl_2 \rightarrow ClCH_2{\cdot}CHCl_2 \xrightarrow{HCl} CH_2{:}CCl_2 \quad (14)$$

The chlorination of vinyl chloride is carried out in the presence of a chlorination catalyst such as ferric chloride. The preferred method involves liquid-phase operation. Among suitable solvents, the use of the product itself (i.e. 1,1,2-trichloroethane) is advantageous by minimizing subsequent purification problems. Some of the earlier workers in the field recommended the use of excess vinyl chloride to suppress the formation of over-chlorinated products.

By operating at suitable conditions, Howell[23] has been able to obtain very high yields (95-96%) of 1,1,2-trichloroethane by the chlorination of vinyl chloride in the presence of a slight excess of chlorine. The evident advantages of this approach include conservation of the costlier raw material (vinyl chloride) and its substantially complete conversion. The claim is made that, as a result, the crude chlorination product may be subjected to dehydrohalogenation as is. Where vinyl chloride is found in the intermediate product, purification at this stage is necessary since fine separation of vinyl chloride from vinylidene chloride imposes considerable burden on the product purification system.

The chlorination reaction is carried out by the introduction of gaseous vinyl chloride and chlorine (in 1-5% excess) into a reactor containing approximately 0.5% ferric chloride suspended in 1,1,2-trichloroethane. Operating temperature is 85-105° F. For optimum yields, good agitation and adequate means for removing the exothermic heat of reaction are essential. A continuous overflow is taken and freed of entrained catalyst on its way to caustic dehydrohalogenation for the ultimate production of vinylidene chloride.

Vapor phase chlorination at 280-300° F has been covered by the patent literature[24], but there is no indication that this method has been employed on a commercial scale. Overall yields as high as 95% of theory are claimed. In the operation of this system large excess of vinyl chloride must be employed in order to maintain chlorine concentration below the explosion or ignition points.

Still other chlorination systems for vinyl chloride have been proposed and are noted here briefly for the record. Included is the use of a salt bath made up of aluminum chloride, sodium chloride and ferric chloride, and operated at 570-800° F. Only 60-65% yield is obtained in this process[25]. A claim has been advanced that the direct chlorination of ethylene can be carried out at 70-80° F to produce 1,1,2-trichloroethane in 70% yield.

The dehydrohalogenation of 1,1,2-trichloroethane is preferably carried out in alkaline medium. Considerable work has been done to achieve a commercially feasible process for vapor phase dehydrohalogenation akin to the system described above for the production of vinyl chloride from dichloroethane. The evident advantage of such an approach is the realization of hydrogen chloride, i.e. a by-product of value. It is, however, found that the vapor phase dehydrohalogenation of 1,1,2-trichloroethane (e.g. over alumina catalyst at 570-750° F) leads to mixtures of sym-dichloroethylene and the desired as-dichloroethylene (vinylidene chloride) with the former predominating.

Caustic dehydrohalogenation of 1,1,2-trichloroethane may be effected commercially in good yield in the presence of milk of lime or of caustic soda. Thus, a yield slightly exceeding 90% of theory has been reported[26] for the reaction of 1,1,2-trichloroethane with a slight (2-10%) excess of milk of lime in 10-20% concentration. The operating temperature is 140-180° F.

Thorough agitation is required to bring about the necessary contact between the organic and aqueous phases. The vinylidene chloride evolved passes through an overhead dephlegmator which serves to condense volatilized trichloroethane and allows it to be returned to the reaction system. Make-up trichloroethane is fed to the reactor at a rate equalling the rate of vinylidene chloride evolution. The reaction is thus carried out semi-continuously. At the conclusion of the low-temperature reaction period, the trichloroethane feed is discontinued and the batch temperature is raised 212° F to complete the distillation of vinylidene chloride.

Alternately, the reaction may be carried out on a completely continuous basis by operation around 210° F, though at somewhat reduced yields.

Higher yields may be obtained by dehydrochlorination with caustic soda. Thus, Howell[23] dehydrohalogenates the crude product of vinyl chloride chlorination (see above) with 10-20% aqueous caustic soda at conditions similar to those described above for lime treatment. An overall vinylidene chloride yield of 90% (based on vinyl chloride) is reported.

The products of reaction must be carefully purified by fractionation. Additional purification includes treatment with epoxides (e.g. ethylene oxide) to remove the presence of metals which tend to lower the storage stability of vinylidene chloride. One commercially utilized method of after-purification includes washing with dilute sulfuric acid, caustic, and finally with ferrous sulfate solution. The washed products is after-treated with silica gel.

Because of its strong polymerization tendency, monomeric vinylidene chloride must be stored in the dark and in the absence of oxygen. Suitable polymerization catalysts include thymol and alkylated naphthylamines.

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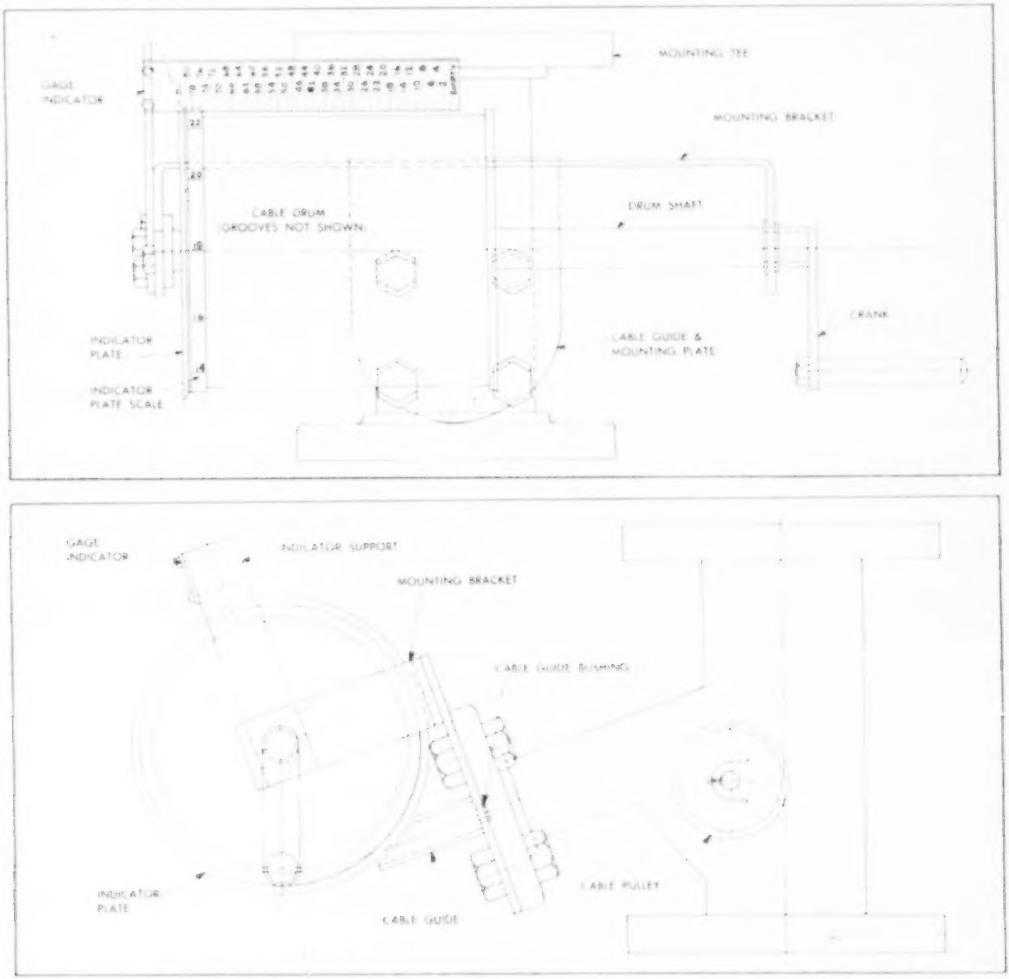

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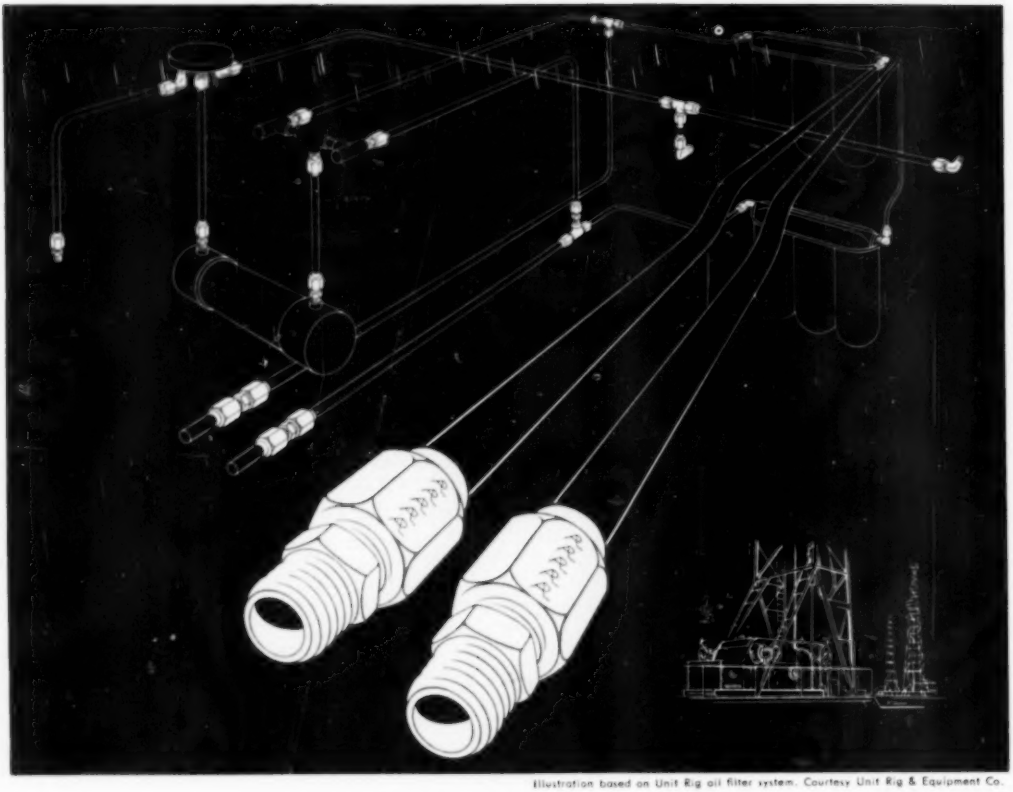

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PORTLAND, Ore.	Hydraulic Power Equipment Co. 2316 N. W. Sawyer St. (10)
ROANOKE, Va.	Noland Company 11 Salem Ave. (10)
ROCKFORD, Ill.	Rockford Tool & Transmission Co. 802 Broadway
SAN FRANCISCO, Cal.	General Machinery & Sup. Co. 1346 Folsom St. (3)
SEATTLE, Wash.	Palmer Supply Co. 222 Westlake Ave., North (9)
ST. LOUIS, Mo.	Metal Goods Corp. 5239 Brown Ave. (15)
SYRACUSE, N. Y.	Whitehead Metal Products Co. 207 West Taylor St. (14)
TOLEDO, O.	Williams & Co. 650 E. Woodruff Ave. (2)
TULSA, Okla.	Ardun Supply Co. 317 S. Detroit Metal Goods Corp. 302 North Boston (3)
CANADA	Railway & Power Engineering Corp. Ltd.
EXPORT	Mercator Corp. 438 Walnut St. Reading, Pa.

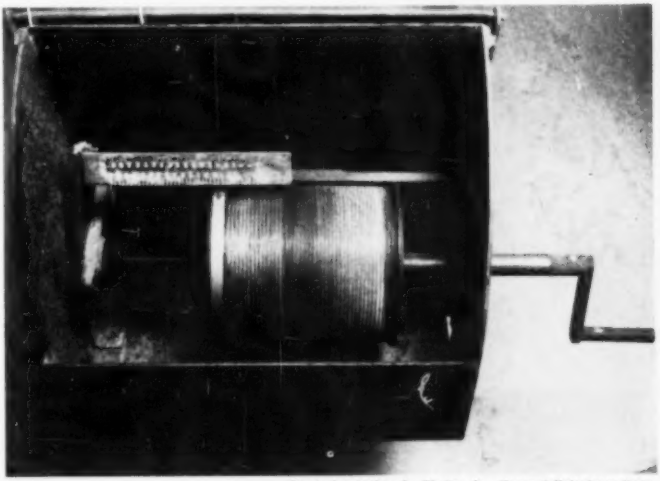


Photo by Arthur L. Thelin, Jr., General Petroleum Corp.

RUGGED CABLE provides long service life in catalyst storage indicator. Enclosure keeps catalyst dust out

position. The numerical indications on this indicator have been set up to show the actual feet of catalyst in the storage hopper rather than the length of wire to the top of the catalyst bed. When a reel of steel tape is used for measuring, it is common practice to take the depth of the free space, then subtract that from the overall depth of the bin to determine the amount of catalyst.

With this device, a finer indication down to one-inch depth of catalyst can be obtained from the calibrations on the indicator plate mounted on the band at the end of the drum.

The weight used as a plumb bob by General Petroleum is a truncated cone with the apex at the top. The broad base strikes the surface of the catalyst bed without sinking in. The metal plumb bob is 3 in. in diameter at the base, 1 in. in diameter at the top and is about 6 in. long.

Here's the way the storage indicator works:

The operator unhooks the handle and allows the cable to unwind by rotating the drum at a moderate speed. When the plumb bob hits the catalyst bed in an 80-ft. cylindrical hopper, the reading in feet on the gage indicator directly above the edge of the drum indicator plate is added to the reading in inches on the indicator plate. The total represents to within one inch, the depth of catalyst in storage. The cable is then wound back up and secured at a zero reading until the next gage is taken.

Advantages of the contrivance are summed up as follows:

1. Main advantage is that the cable is sturdier than the tape, so problem of tape-measure breakage has been solved.

2. Broken tapes in a storage bin can impede the flow of catalyst, especially if the storage level is low. So this problem, too, is overcome.

3. All equipment from which readings are taken is kept out of the catalyst, thus remaining free of the catalyst dust which wears down the figures by abrasion when gaging tape is used. This, according to the company, has tended to eliminate erroneous readings which sometimes result.

Got a Headache?

How can you keep catalyst from plugging up in small size stainless steel tubing (⅛-in. I.D.) such as is used in a pilot plant catalytic cracking unit?

That's one of a number of questions of all types we've received lately from our readers. If you have an answer, send it in. It's good material for this Plant Practices section.

Or maybe you have some problem of your own you'd like answered. Send that in too. We'd like to try to help you on your "headaches" if we possibly can. If you wish, we'll keep the whole thing anonymous. Your name or your company connection need not appear in print. The important point is your problem and how to solve it.

Plant Practices Editor
PETROLEUM PROCESSING
1213 West Third St.
Cleveland 13, Ohio

(*To obtain more data on advertised products see page* 1840)

...speediest, longest-lasting alcohol resistant foam ever produced!

Here at last is a really effective extinguishing agent for use against fires in water soluble solvents . . . Pyrene* Alcohol Resistant Foam (patent pending). This brand-new compound produces far and away the most stable foam ever known. Its effective life can be measured in *hours and days* instead of mere minutes. The blanket it provides stays on long after there is any chance of flames breaking out again. Actually, Pyrene Alcohol Resistant Foam is more than its name implies. It is really an *all-purpose* foam—effective against all flammable liquid fires—gasoline, oils, paints, alcohols, ketones, esters and ether. For complete information, write Pyrene.

*T.M. Reg. U.S. Pat. Off.

Pyrene AIR FOAM

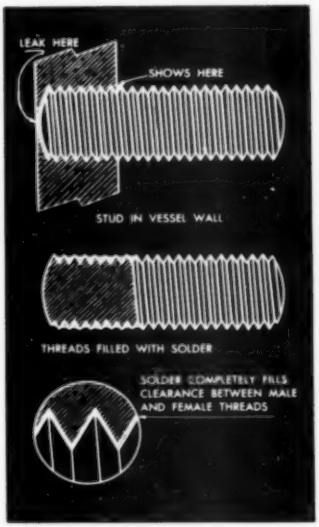
PYRENE MANUFACTURING COMPANY
681 Belmont Ave., Newark 8, New Jersey
Affiliated with C-O-Two Fire Equipment Co.

ed from use of worn tapes.

Durability of the device has been tested in use. Tape-snapping has been a commonplace experience when the plumb bob dips into the catalyst. This cable, however, has sufficient strength to withstand the strain of pulling the bob up out of the catalyst bed without breaking.

This was a custom-built instrument made in the Torrance machine shop. No commercial value has been specified, but it would cost an estimated $200 to build such a device.

One indicator is now in service at the refinery. There are four possible locations, and General Petroleum is contemplating further installation.


LEAK HERE
SHOWS HERE
STUD IN VESSEL WALL
THREADS FILLED WITH SOLDER
SOLDER COMPLETELY FILLS CLEARANCE BETWEEN MALE AND FEMALE THREADS

Easy Repair for Leaks In Stud Bolt Holes

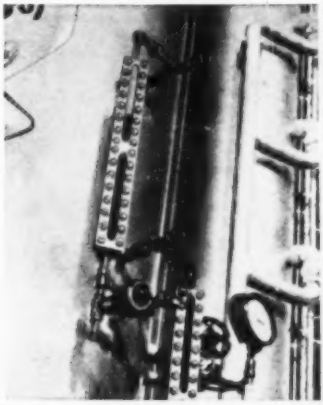
By F. R. STIVISON*

We have had a number of leaks develop where stud bolts were screwed into pressure vessels. In some cases the bolts were apparently drilled completely through the plate, and in others loss of metal from corrosion had caused pressure to reach the stud hole.

In any event, gas or fluid reaching the stud hole would follow the path of the threads and show up as a leak at the surface. Because the bolt threads are not tapered, additional tightening of the stud has little effect. The following method has been applied to the problem with complete success.

The stud is thoroughly cleaned

BLACK WHITE VISIBILITY



JERGUSON Series #5 Reflex Gages Give you up to 19¼" of Clear Visibility

THE sharp black-white contrast of the liquid level against the empty space above, in Jerguson Series #5 Reflex Gages, makes possible highly accurate liquid level readings even where lighting is poor.

To give you extra long service, the gages are corrosion resistant; and the glasses are specially treated with Jerguson Anti-Fouling Compound to give clearest visibility over a long period.

Series #5 Low Pressure Reflex Gages are available in sections to give you any desired total gage length. Materials used are selected to conform to or exceed the rigid requirements of A.I.S.I., A.S.T.M., and or A.P.I.-A.S.M.E. specifications.

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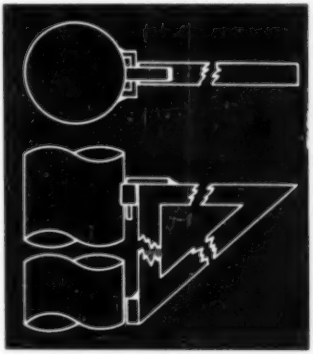
and then tinned with solder for a length equal to the depth of the hole in which it is to be inserted. See the sketch. Solder is then added until the threads are almost completely filled. After the solder cools, the stud is screwed into place. The solder will fill the clearance space between the threads on the hole and those of the stud, effectively sealing off any leakage. The method has been found advantageous over seal welding in that the stud can be easily removed if desired.

[illegible] is an employee of Continental Oil Co., Lake Charles, La. This item is based on his award-winning "Plant Kink" from the southern regional meeting of the National Association of Corrosion Engineers, Tyler, Texas, October 21, 1952.

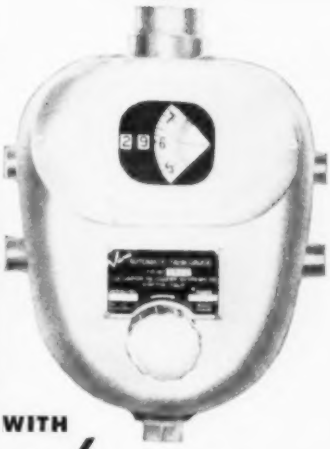


Quick Method for Overhead Scaffolding

MANY overhead maintenance jobs around a refinery recur regularly so that it becomes not only monotonous but uneconomical to rebuild wood scaffolds each time they have to be done. Therefore, why not make scaffolds and working platforms relatively standard and arrange for their being quickly and easily put up and removed?"

With this thought in mind maintenance department personnel at the Baltimore refinery of Esso Standard Oil Co. worked out the following system. They weld small hangers on the vertical column supports for overhead piping and on the outside walls of various tanks (see sketch). The angular frames for supporting the working platforms are provided with a hook at the 90° corner, which slips into the 2 x ¾-in. strap iron hanger on the column or tank. In addition Esso has made up a stock of clamps with the hangers attached. These clamps can be quickly bolted to piping for any short, temporary job where it is not desirable to have a hanger attached permanently.

Take the Guesswork out of Gauging



WITH "Varec" Fig. No. 2500

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FOR ALL TYPES OF LOW PRESSURE TANKS

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The Fig. No. 2500 is also adapted for installation of "VAREC" Electronic Remote Reading Gauging equipment and Electronic Hi-Lo Limit or Controller Switches. Write today for full information or send coupon below!

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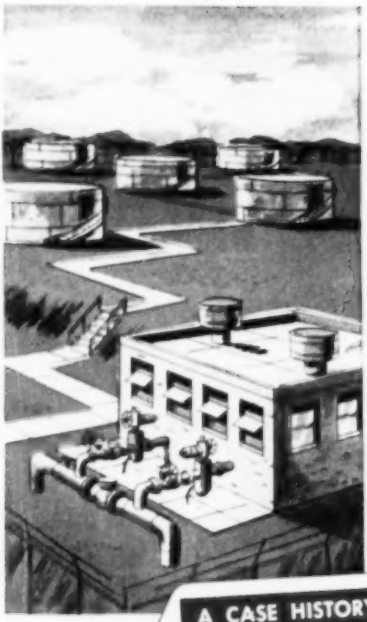

Are pipeline systems a source of copper contamination of gasoline?

A CASE HISTORY:

An oil company recently started to transport gasoline through a new products pipeline. The gasoline entered the pipeline with an induction period of 14 hours. But it had an induction period of only 5 hours when it left the system 416 miles away.

To determine the source of contamination, the copper content of the gasoline was checked at various points along the pipeline. It was found to be building up in proportion to the miles traveled through the line. And it increased from .10 ppm initially to .22 ppm at the destination.

Copper heat exchanger coils and copper alloy pump impellers at the pump stations along the line were found to be the source of trouble.

DU PONT METAL DEACTIVATOR was added to the gasoline at the pipeline exit to offset the harmful effects of the copper. In this case, it was found that only $\frac{1}{4}$ lb. of deactivator per 1,000 barrels of gasoline was needed to restore the original 14-hour induction period.

FOR LESS THAN $2 PER 1,000 BARRELS you can *be sure* your gasoline is free from the harmful effects of copper contamination which may be encountered *after* it leaves the refinery . . . with Du Pont Metal Deactivator. Since many distribution systems contain valves, pumps and various fittings which are a potential source of copper contamination, this is an important, low-cost way of assuring greater customer satisfaction. Normally, we would recommend that Metal Deactivator be added to the gasoline at the refinery, *before* it enters the distribution system.

Ask your Du Pont Petroleum Chemicals Division representative for samples and further information on Du Pont Metal Deactivator.

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. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)

PETROLEUM PROCESSING PATENTS

By Peter J. Gaylor, *Patent Attorney, Gaylor, Cifelli & Jurick, Newark, N. J.*

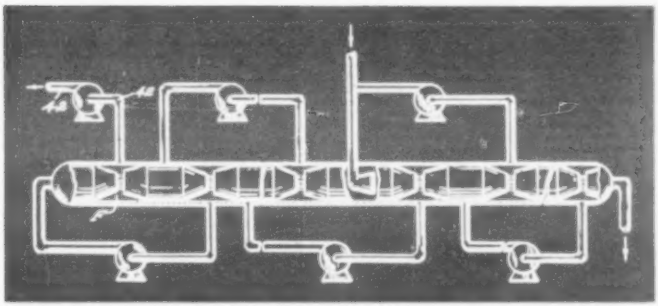

FIG. 1—Jet diffusion system developed by The Texas Co. for separation of gases (U. S. Patent 2,607,439)

Diffusion Process for Separating Gases Getting Attention of Petroleum Industry

SINCE our recent article on the Koppers Co. diffusion process for separating gases, several additional patents were issued, indicating activity in this field in the petroleum industry. And, because the mechanics of the separation process already have been discussed in detail in the previous article (PETROLEUM PROCESSING, Aug. '52, p. 1167), we shall take up only the new process features claimed to be novel in the more recent patents.

In The Texas Co. patent 2,607,439, a series of jets is employed, as illustrated in Fig. 1. There is no diaphragm. An example is given of a gas mixture (56.1% N_2 and 43.9% H_2) which was passed through a single jet such as one of those (F) in the series shown in Fig. 1. The diffused product withdrawn from the space about the surfaces of the jet (through line 42) was found to contain 31.5% N_2 and 68.5% H_2. A counter-current system such as that shown Fig. 1 would be necessary to effect substantial purification.

Fig. 2 shows vertical and horizontal cross-sectional views of a diffusion apparatus claimed by Hydrocarbon Research, Inc. in its U. S. Patent 2,609,059. The gas mixture enters through inlet 23, while a condensible gas, such as steam, is introduced through and dispersed by distributor tube 19. A cylindrical porous diaphragm or barrier 16 is employed, preferably of porous stainless steel of 0.005-0.25 in. thickness and having 1-30% free area comprising holes of 1-20 microns diameter. The diffused gas is removed through outlet 26. Annular chamber 15 may be used for cooling water.

In order to obtain reasonably pure light and heavy gas products, a counter-current system of diffusion cells is employed. An example is given in passing a mixture containing 50% CO and 50% H_2 into a two-cell apparatus, resulting in a product gas containing 81% CO, 9% hydrogen and 10% water vapor.

Catalytic Dehydrogenation In Presence of CO_2

ONE petrochemical process which appears to have some merit is the dehydrogenation of low molecular saturated hydrocarbons in presence of carbon dioxide, producing an olefin and carbon monoxide, suitable for synthesizing acids such as propionic acid, etc. In its U. S. Patent 2,604,495, Hercules Powder Co. describes such a process employing an iron oxide catalyst.

In one example, ethane and carbon dioxide, in the ratio of 1.77 moles of carbon dioxide per mole of ethane, were passed through a heated tube containing a promoted iron oxide composed of 28.38% FeO, 65.93% Fe_2O_3, 0.4% Al_2O_3, 0.01% CuO, 0.6% SiO_2, 4.1% MgO, 0.4% CaO, and 0.004% MnO, which had been reduced previously by hydrogen. The reaction temperature was 850° C., and the contact time 0.986 sec. The reactor exit gases had the following analysis:

C_2H_4	19.5%
CO	23.9%
CO_2	34.7%
C_2H_6	6.4%
H_2	14.6%
CH_4	0.9%

This represents a 68.7% conversion of ethane to ethylene and a 45% conversion of carbon dioxide to carbon monoxide. The gas mixture is suitable for direct use in the carboxylic acid or anhydride synthesis without any previous purificaton, preferably usng a catalyst such as nickel carbonyl.

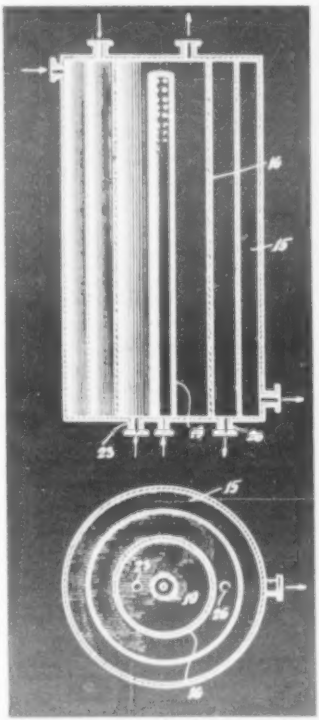

FIG. 2—Diffusion apparatus patented by Hydrocarbon Research for separating gases (U. S. Patent 2,609,059). Vertical cross-sectional view at top, horizontal view at bottom

Patents Issued in October

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as continued in the Official Gazette of the U. S. Patent Office for October 7, 14, 21, and 28, Vol. 663, Nos. 1-4.

PROCESSES

Conversions

2,613,173 (Sinclair Refining Co.) Process for the catalytic conversion of hydrocarbons and the stripping of the fouled catalyst particles with steam.

2,614,054 (Foster Wheeler Corp.) Catalyst vessel.

2,614,068 (Standard Oil Co. (Ind.)) Multiunit catalytic cracking operations.

2,614,069 (Standard Oil Development Co.)

Catalysts

Hydrocarbon Synthesis

Refining

PRODUCTS

Chemicals

Fuels

Lubricants

Specialties

2,613,131 (Hale, H. O.) Process of reducing the corrosion of ferrous metals by ammonium acetate and corrosion inhibiting fluid.

2,613,302 (Armstrong Cork Co.) Linoleum compositions containing cyclic petroleum fractions.

2,614,063 (Standard Oil Development Co.) Process for inhibiting corrosion in oil well drilling strings.

2,615,781 (Standard Oil Development Co.) Herbicide of reaction of arsenic trichloride.

2,615,815 (Shell Development Co.) Corrosion inhibiting composition.

2,615,820 (American Bitumuls & Asphalt Co.) Bituminous emulsion.

2,615,827 (Standard Oil Development Co.) Herbicidal weed killer preparations containing chlorinated phenoxyacetic acid.

2,615,851 (American Bitumuls & Asphalt Co.) Bituminous emulsions.

Miscellaneous

2,614,926 (Bell Oil Co.) Vacuum pump suction muffler.

2,614,111 (Phillips Petroleum Co.) Process of refining glycerin so as to liquid paraffins mixed with a concentrated alcoholic alkali metal hydroxide solution.

2,614,921 (The Texas Co.) Weather-resistant concrete containing asphalt oil.

EQUIPMENT

Processing, general

2,613,136 (Phillips Petroleum Co.) Fractional crystallizer.

2,613,138 (De Directie van der Staatsmijnen in Limburg, Heerlen, Netherlands) Gas-solid contact reactor.

2,613,140 (Gulf Research & Development Co.) Apparatus for producing synthesis gas by conversion of hydrocarbons.

2,613,811 (Standard Oil Development Co.) Continuous settling apparatus for gravity separation of emulsions of materials substantially immiscible and of dissimilar specific gravities.

2,613,924 (Sweet's Vacuum Oil Co., Inc.) Heater for granular solid heat transfer material.

2,614,911 (Standard Oil Development Co.) Liquid-liquid extraction tower.

2,614,960 (Gulf Oil Corp.) Hydrodesulfurization reactor.

2,614,— (Phillips Petroleum Co.) Evaporative crystallizer apparatus and process.

2,614,064 (Phillips Petroleum Co.) Apparatus and method for liquid-liquid contacting.

2,614,067 (Union Oil Co. of Calif.) Coking process and apparatus for hydrocarbon conversion in the presence of spent solid particles.

2,614,853 (Sweet's Vacuum Oil Co., Inc.) Apparatus for recovery of solid materials from continuous contact filtration process.

2,614,248 (Howard F. Ritch) Centrifuge for separating solids.

2,614,923 & 4 (Phillips Petroleum Co.) Pebble heaters.

2,614,909 (Phillips Petroleum Co.) Fractionation apparatus.

2,614,910 (Union Carbide and Carbon Corp.) Continuous polymerizing apparatus.

2,614,— (Phillips Petroleum Co.) Pebble heater and method of converting hydrocarbons.

2,614,— (Metropolitan-Vickers Electrical Co., Ltd.) Short path fractionating still.

2,615,912 (Union Carbide and Carbon Corp.) Apparatus and process for eliminating impurities during the separation of gas mixtures.

2,615,— (Westinghouse Electric Corp.) Electrostatic precipitator.

2,615,530 (Air Pressure Corp.) Liquid cooled electrostatic precipitator.

2,615,— & — (Patterson Foundry & Machine Co.) Apparatus for dispersion of a gas in a liquid.

2,615,700 (Imperial Chemical Industries Ltd. [England]) Apparatus for contacting liquids with gases or vapors.

2,615,— (Phillips Petroleum Co.) Pebble heating chamber.

2,615,792 (Standard Oil Development Co.) Apparatus for separating two-phase mixtures.

2,615,793 & 4 (Phillips Petroleum Co.) Crystallization apparatus.

2,615,— (Imperial Chemical Industries Ltd. [England]) Packing for a distillation column.

Catalytic Reactors

2,614,— (Foster Wheeler Corp.) Catalyst vessel.

2,615,— (Westinghouse Electric Corp.) Catalytic gas generator.

2,615,— (Standard Oil Development Co.) Vessel for fluid catalytic reaction with means for cutting heads of the dense phase.

Instruments

2,612,781 (Rockwell Mfg. Co.) Thermo responsive coupling for a differential pressure motor of the orifice type.

2,612,— (Taylor Instrument Co.) Differential pressure sensing unit.

2,613,— (Ball Bros. Co.) Vacuum pump and unit control.

2,613,— (Radio Corp. of America) Electronic computing device.

2,613,— (Arnold O. Beckman) Apparatus for recording gas concentration in the oil in propane.

2,613,— (Consolidated Engrg. Corp.) Device for finding mass spectrometer on a preselected mass peak.

2,613,— (Paul L. Brown) Liquid level gage.

2,613,— (United Gas Pipe Line Co.) Method and device for transferring liquid samples from pressure vessels.

2,614,— (James H. Carleton) Fluid flow orifice structure.

2,614,— (Builders Iron Foundry) Pneumatically actuated fluid pressure meter.

2,614,— (Clifford J. Amsler & Co., Schaffhausen, Switzerland) Apparatus for velocity measurement of a moving fluid.

2,614,— (Westinghouse Electric Corp.) Liquid level gage.

2,614,— (Eastman Kodak Co.) Liquid level indicator.

2,614,— (James M. Reed) Metering thermometer.

2,614,— (Gulf Research & Development Co.) Buoyancy type liquid flow meter.

2,614,— (Taylor Instrument Co.) Pilot relay valve.

2,615,— (Sun Oil Co.) Flow meter with heating protector.

2,615,— (Foster Wheeler Corp.) Liquid level indicator.

2,615,— (Sun Oil Co.) Liquid sampler.

2,616,— (Shell Development Co.) Automatic temperature control.

Pumps & Compressors

2,612,— (American Engineering Co.) Rotary sealing pump.

2,612,— (A. O. Smith Corp.) Motor controlled pump with lubricated rotors.

2,612,— (Robbins & Myers, Inc.) Helical gear pump with hot liquid casing.

2,613,— (Milton Roy Co.) Proportioned metering pump of reciprocating type.

2,613,— (Milton Roy Co.) Bellows pump.

2,613,— (Milton Roy Co.) Differential bellows pump.

2,614,— (A. R. Wilfley and Sons, Inc.) Centrifugal pump.

2,615,— (Peerless Machinery Corp.) Rotary pump of the positive displacement type.

Valves & Fittings

2,613,— (H. O. Turner) Steam trap.

2,614,— (Mads Clausen and Christian Mathiesen Nordberg, Denmark) Pilot-operated valve.

2,614,— (Phillips Petroleum Co.) Pressure sensed relief valve.

2,614,— (Crane Co.) Guide for gate valve.

2,615,— (Reconstruction Finance Corp.) Temperature controlled valve with a bellows type seal.

2,615,— (Hills-McCanna Co.) Valve diaphragm.

2,615,— (Leland & Homer Paul A. Dewey) Pipe line blind.

2,615,— (Tri-Clover Machine Co.) Lift plug valve.

2,615,— (Columbia-Southern Chemical Corp.) Excess flow check valve.

Miscellaneous

2,613,— (George E. Grindmeier) Thermal insulation fabricated of heat reflective metal sheets in layers.

2,613,— (Pure Oil Co.) Fairing fin type of vacuum still with a rotating partial condenser.

2,613,— (Universal Oil Products Co.) Fluid heater.

2,614,— (Combustion Engineering-Superheater, Inc.) High temperature fluid heater.

2,614,— (John H. Wiggins) Floating tank roof.

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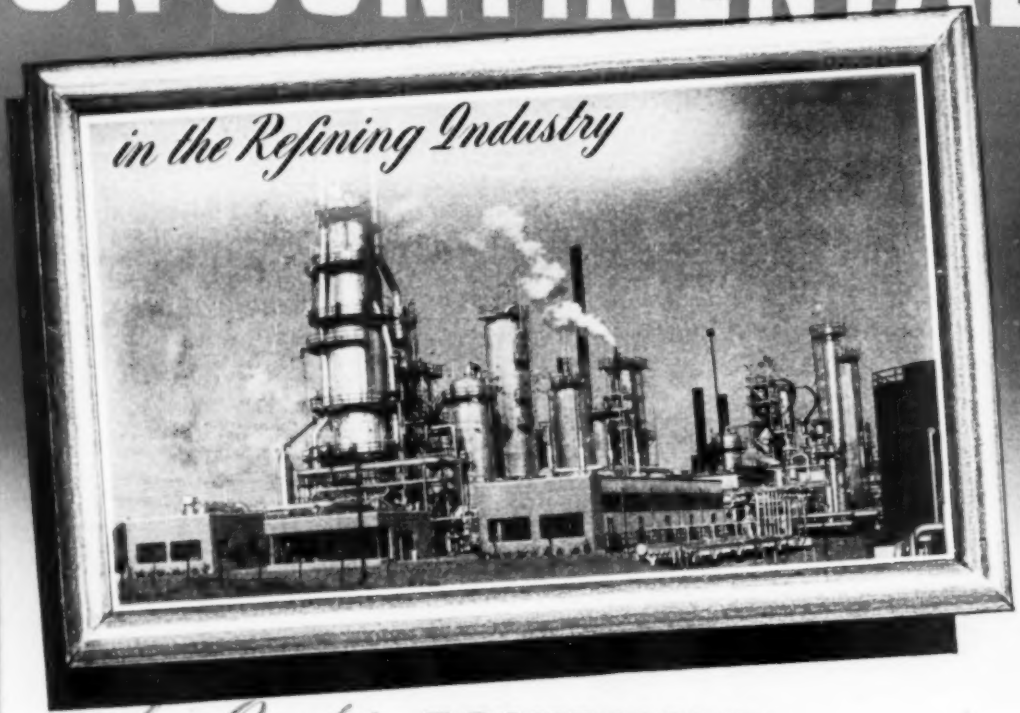

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NLGI Honors T. G. Roehner

IN APPRECIATION FOR OUTSTANDING SERVICE during the past year, **George E. Merkle** (left), president of the National Lubricating Grease Institute, congratulates **T. G. Roehner,** chairman of the NLGI technical committee, as he presents him with an award at the Institute's annual banquet. Mr. Roehner was largely responsible for a highly integrated program of cooperation with other industries either using greases or producing products identified with its production and use. Mr. Roehner is director of Socony-Vacuum Oil Co.'s technical service department.

George W. Miller, president of Battenfeld Grease and Oil Corp., also received a similar award from the Institute.

E. G. Wiley and **P. T. Oak** have been appointed assistant general superintendents at the Whiting refinery of Standard Oil Co. (Ind.). Mr. Wiley is promoted from superintendent of the asphalt division, and Mr. Oak from assistant superintendent of the heavy oils division at Whiting.

* * *

Ralph Deeds has been transferred to International Petroleum Co.'s refinery at Baranca, Colombia, South America, as assistant manager. He was formerly general foreman of Esso Standard Oil Co.'s refining division at Baton Rouge, La.

* * *

Dr. Christian V. Holland has been named director of chemical research of the Spencer Chemical Co. He will make his headquarters at Pittsburg, Kansas, the company's general operating headquarters. He holds a chemical engineering degree from the University of Virginia, an M. S. from Massachusetts Institute of Technology, and a Ph. D. from Johns Hopkins University. Dr. Holland was formerly coordinator of manufacturing facilities for Sterling Drug, Inc.

Four new directors were elected and four directors reelected to the board of Ethyl-Dow Chemical Co., a petrochemical firm jointly owned by the Ethyl Corp. and the Dow Chemical Co. Board membership was increased from six to eight with the election of **Joseph A. Costello,** an Ethyl vice president, and **Donald K. Ballman,** Dow general sales manager, to the newly created posts. **B. Bynum Turner,** an Ethyl vice president, and **Calvin A. Campbell,** Dow vice president, were elected to the vacated positions of secretary and general counsel, respectively.

Reelected directors are: **Ivan F. Harlow,** president; **Earl W. Bennett,** vice president; **John H. Schaefer,** vice president; and **Stanley T. Crossland,** treasurer. **J. P. Dooher** was elected secretary and assistant treasurer, and Mr. Campbell was elected assistant secretary.

Mr. Harlow is inorganic chemicals production manager, and Mr. Bennet is chairman of the board, of Dow Chemical. Mr. Schaefer is vice president and Mr. Crossland, vice president and treasurer, of Ethyl Corp.

John W. Newton, vice president and manager of refining with Magnolia Petroleum Corp., is the newly-elected vice president of the Refining Division, American Petroleum Institute, succeeding **W. L. Stewart,** executive vice president of the Union Oil Co.

Mr. Newton

Mr. Newton has been with Magnolia since 1914 when he joined the company as a chemist. After successive promotions, he became director and vice president in 1938. He has been a member of the general committee of the API division of refining, and is a past vice chairman of that committee.

In his first official act he has made the following API appointments:

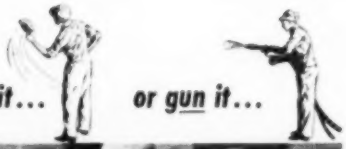
C. E. Headington, Atlantic Refining Co., to succeed **E. L. Baldeschweiler,** Standard Oil Development Co., as chairman of the Committee on Analytical Research; **Dean S. Turner,** Standard Oil Co. (Ohio), to succeed **Taylor M. Rushing,** The Texas Co., as chairman of the Committee on Training; and **C. M. Ridgway,** Pure Oil Co., to succeed **W. M. Holaday,** Socony-Vacuum Oil Co., as chairman of the Program Committee.

Reappointed chairmen are: **John T. McCoy,** Tide Water Associated Oil Co., Automotive Research Committee; **Albert E. Miller,** Sinclair Refining Co., Committee on Petroleum Products; **R. N. Gibs,** Standard Oil Co. (Ind.), Committee on Disposal of Refinery Wastes; **W. H. Creel,** Phillips Petroleum Co., Committee on Refinery Equipment; and Mr. Stewart was reappointed chairman of the Smoke and Fuels Committee.

* * *

Dr. R. W. Millar has been appointed head of the chemical engineering department at Shell Development Co.'s Emeryville, Calif. laboratories. He relieves **Mott Souders, Jr.,** who has been acting head of the department. Mr. Souders is now free to devote his attention to his principal duties as an associate director of development. **Dr. C. L. Dunn** has succeeded Dr. Millar as head of the physical chemistry department, a position Dr. Millar has held since the formation of the department.

Dr. Millar received his B. S. and M. S. degrees from the University of Illinois and his Ph. D. from the University of California. Prior to joining Shell Development in 1928, he was on the faculty at the University of California, Los Angeles, and



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Personals

spent several years with the U. S. Bureau of Mines.

Dr. Dunn joined the company in 1937 and has been assigned continuously to the physical chemistry department. In 1946 he was appointed assistant department head. He holds B.S. and M.S. degrees from the University of Washington, and a Ph.D. from California Institute of Technology.

* * *

Richard E. Lauterbach has been named manager of General Petroleum Corp.'s newly-announced $35-million refinery, to be built in Ferndale, Wash. At present Mr. Lauterbach is assistant manager of GP's Torrance, Calif. refinery. During the initial portion of the two years that the new refinery will take to construct, Mr. Lauterbach will make his headquarters at GP's home office in Los Angeles. As construction progresses, he will move to the Ferndale area.

Mr. Lauterbach

Mr. Lauterbach is a native of San Diego, Calif. He graduated with honors in chemistry from the University of California at Los Angeles and joined GP immediately upon graduation in March 1936, as a laboratory assistant. He became a chemical engineer in 1939, a position he held for the next six years in the company's Laboratories' Department. In 1945 he was assigned to the Torrance refinery as a refinery engineer and in 1950 became assistant manager.

* * *

At Whiting the following appointments have been made in Standard Oil Co.'s (Ind.) research divisions: **L. C. Brunstrum** to section leader and **H. J. Liehe** to group leader, greases; **A. W. Lindert**, section leader, and **R. S. Barnes**, group leader, industrial lubricants; **T. B. Tom**, section leader, and **R. A. Hunt**, group leader, light oils; **R. A. Dinerstein**, group leader, fractional distillation and hydrocarbon analysis; **Dr. Marvin Den Herder**, group leader, catalyst research; and **J. W. Mahlman**, group leader, information services.

In the technical services divisions at Whiting the following have been advanced: **Dr. Moses Gordon** to section leader, light and heavy oils finishing and asphalt manufacture; **W. E. Stanley**, group leader, light oils finishing; **R. B. Selund**, section leader, distillation, coking, heavy oils processes, and acid manufacture;

Personals

W. E. McGinnity, group leader, heavy oils processes and acid manufacture, **E. R. Walter,** section leader, and **G. M. Goodman,** group leader, economics.

* * *

Two Standard Oil Development Co. engineers have been given new assignments in the engineering department of the Esso Standard Oil Co. They are: **Arthur L. Saxton,** promoted to senior project engineer, and **Hollister B. Sykes,** who was named a group leader.

Mr. Saxton joined the parent company as a student chemical engineer following graduation from Syracuse University in 1941. After completion of the company's student-engineering course, he was assigned to the Standard Oil Co. of Louisiana, where he remained until transferred to SOD in 1944.

Mr. Sykes began his career with the company as a student engineer, and has been in the Esso engineering department since 1949. He holds a B. S. in chemical engineering from Princeton University and an M. S. from the University of Pennsylvania.

* * *

G. W. Seymour, vice president of Celanese Corp. of America, has been named to the newly-established position of coordinator of process and technical control. In his new position, Mr. Seymour will be responsible for integrating and maintaining liaison among the corporation's three operating divisions, namely, textile, plastic, and chemical. He will also coordinate activities of affiliated companies in Canada and Latin America on all matters pertaining to process and technical control.

* * *

Dr. B. B. Allen has been appointed manager of Celanese's Summit, N. J., research laboratories. Previously he had been associate director of the laboratories.

* * *

Dr. Wayne T. Barrett has been appointed manager of the research department in Davison Chemical Corp.'s research and development division. He received B. S. and M. S. degrees in chemistry at Michigan State and his Ph. D. from the University of Pittsburgh. Dr. Barrett was formerly with the Phillips Petroleum Co. and the Mellon Institute, where he was a junior fellow in catalytic research. He joined Davison in 1950.

* * *

Louis V. Cassaday has been named president of the Lomita Gasoline Co., Long Beach, wholly-owned subsidiary of the Standard Oil Co. (Cal.). He succeeds **H. C. Judd,** treasurer of the parent company. Mr. Cassaday, who has been with Lomita since Jan. 1, 1924, was vice president and general manager prior to elevation to the presidency.

* * *

Dr. Eger V. Murphree, president of Standard Oil Development Co., has been named as the 1953 recipient of the Industrial Research Institute Medal. Actual presentation of the award will be made next April at the annual meeting of the Institute, to be held at White Sulphur Springs, W. Va. The medal, awarded annually since 1945, honors "outstanding accomplishments in leadership in or management of industrial research which contributes broadly to the development of industry or the public welfare."

Dr. Murphree

Dr. Murphree, a graduate of University of Kentucky and Massachusetts Institute of Technology, is a member of the National Academy of Science and the New York Academy of Science, and is president of the Permanent Council of the World Petroleum Congress.

* * *

Louis M. Sherman has been appointed associate director of Ethyl Corp.'s product development in charge of industrial chemicals. He graduated from Massachusetts Institute of Technology in 1938 with a B. S. in chemical engineering. After discharge from the army in 1946 he was associated with American Cyanamid Co. and its subsidiary, Chemical Construction Co. for the next six years.

* * *

Independent Refiners Association of America has reelected **M. H. Robineau,** president of Frontier Refining Co., to head the organization for the coming year. Elected vice president and secretary-treasurer respectively, were: **Lloyd Freese,** vice president of Bell Oil and Gas Co., and **James P. Dunnigan,** president of Producers Refining Inc.

* * *

W. S. Richardson, executive vice president of the B. F. Goodrich Co. has assumed the duties of president of the newly-formed Goodrich-Gulf Chemicals, Inc. Until the new company forms definite plans for activity, Mr. Richardson will function from Goodrich headquarters in Akron, Ohio.

* * *

Continued expansion of the Lemont refinery of Globe Oil and Refining Co., Chicago, brings on a new appointment for that firm—**Dr. W. F. Krause** as technical manager of manufacturing.

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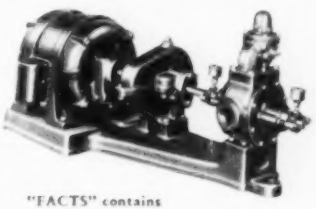

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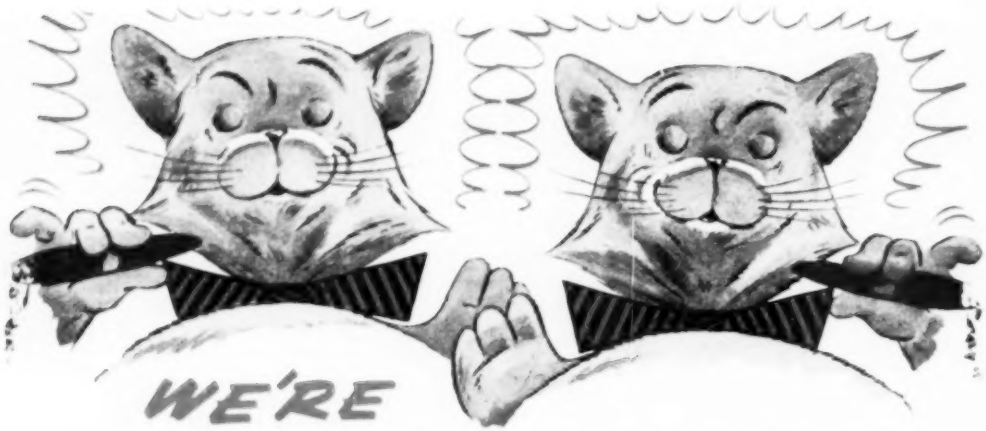

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Mr. Hudson

Mr. Rush

Motley A. Hudson, Shreveport, and Jack W. Rush, Dallas, have formed a manufacturers' representative organization, Hudson-Rush Co., with offices in Shreveport and Dallas. In Shreveport the address is 753 Gladstone Blvd. and in Dallas, 229 Lake Park Center.

The firm will specialize in heat-transfer equipment, controls for process industries and auxiliaries for large engines. Covering the middle portion of the Southwest, their territory will include west, north and east Texas, north Louisiana and Arkansas. Equipment represented includes: Barco flexible and revolving joints, Brown Fintube sectional heat exchangers and elements, Conoflow pneumatic operators and valves, Continental butterfly valves, Kristi Tennite II plastic tubing, Mercoid mercury-switch equipped controls and Perco oil filters.

Both men have been division managers with Eggelhof Engineers, Inc. for the past six years. Mr. Hudson is a Georgia Tech graduate and has previously been with Allis-Chalmers and Magnolia Petroleum. Mr. Rush is a Vanderbilt-Oklahoma graduate and has been with Du Pont, Sunray and Calumet Refining.

Book Writing Contest Announced

R. S. Aries and Associates has established an annual award for the first and second best books in the field of economics of the chemical process industries.

In addition to statuettes, advance royalties of $1500 will be paid the winner and $500 to the second place. Entries may be submitted through July 1, 1953. Presentations will be made in September. Winning manuscripts will be published by Chemonomics, Inc., an Aries affiliate.

In order to be eligible, a book must have a minimum length of 20,000 words and must be written especially for the contest. Chemonomics may publish non-award-winning manuscripts on standard royalty terms if author and publisher agree. Each manuscript must be accompanied by an entry form which may be had upon request from Chemonomics, 400 Madison Ave., New York 17, N. Y. Manuscripts should be addressed to the publisher, and authors should retain carbon copies.

Judges for the competition will be headed by Prof. David D. B. Hertz, Columbia University, and Prof. John Happel, New York University. If, in the opinion of the judges, no manuscripts are found suitable, the awards will be withheld.

Kelly to Cooling Tower Group

Raymond C. Kelly, formerly manager of the equipment division, J. F. Pritchard & Co., has resigned to accept the position of executive manager of the Cooling Tower Institute, an association of major manufacturers of industrial water cooling equipment. He was one of the organizers of the Institute, and served two consecutive terms as its first president.

Mr. Kelly

Named to succeed to Mr. Kelly's post with Pritchard is Karl E. Johnson, Chicago district sales manager for the past six and a half years. E. Allen Bailey succeeds Mr. Johnson at Chicago.

Britt Joins Delta

James R. Britt, formerly with Arkansas Fuel Oil Co., has become associated with Delta Engineering Corp., Houston, Texas, as manager of the construction division. Mr. Britt entered the petroleum industry as a plant engineer for the Cities Service organization in 1936 after receiving a degree in chemical engineering from Louisiana State University.

Mr. Britt

He remained with the firm, serving as plant superintendent for Arkansas Fuel Oil Co., supt. of explosives for Cities Service Defense Corp., construction supt. for Arkansas Fuel, staff executive for the mfg. dept. of Petroleum Advisors, Inc., and most recently as supt. of the natural gasoline division of Arkansas Fuel.

New Positions At Cyanamid

American Cyanamid Co. has created several new posts in the petroleum chemicals department and has also consolidated sales in the department of a wide range of specialty products for the petroleum industry. The additional products are for

UOP Moves to Suburban Chicago

LARGE ENGINEERING DRAFTING ROOM, part of Universal Oil Products Co.'s new administrative and engineering building at Algonquin and Mt. Prospect Rds., Des Plaines, Ill., about 25 miles northwest of the Chicago Loop. A two-story building, it is located on a 54-acre tract. Its completion is the first step in a long range program calling for ultimate centralization of all UOP activities at Des Plaines, including new research laboratories to replace present plant in Riverside, Ill.

Suppliers

use in drilling, production, transportation and refining operations, and for compounding lubricating greases and oils.

Promoted to new posts in the petroleum chemicals department:

R. R. Wainwright, technical director with headquarters in New York; V. R. Farlow, Eastern regional sales manager with headquarters in the New York sales office; E. F. Heizer, Western regional sales manager with headquarters in Chicago; T. O. McDonald, Southern district manager with headquarters in Houston; Read Latson and Charles O. Brown, Jr., sales representatives with headquarters in Chicago.

Fiber Group Changes Name

Industrial Mineral Wool Institute, comprising 18 manufacturers of mineral fiber in the United States, Canada, and abroad, has changed its official name to Industrial Mineral Fiber Institute.

The association, which was formed in 1941, has expanded its activities to parallel the rapidly growing uses of mineral fiber beyond thermal insulation. Administration will be carried on from the New York offices, 141 Lexington Ave., by Frank Christenson, president, and Harry E. Lewis, executive director.

Farley Heads New Annin Office

Ike Farley, who recently joined the Annin Co., has assumed the management of the company's new office located at 6209 Edloe St., Houston 17, Texas. A complete warehouse stock will be maintained under his direction for the convenience of Annin customers along the Gulf Coast.

Mr. Farley

Mr. Farley comes to Annin from the Lummus Co. of Houston where he was a project engineer. He is a graduate of Drexel Technical College in Philadelphia, and has wide experience in the petroleum and chemical fields. For over 20 years he handled special accounts in these fields with the Brown Instrument Co., division of Minneapolis-Honeywell. Mr. Farley will be assisted in his new position by E. H. Callender, a graduate of Armour Institute, and affiliated with the Jefferson Chemical Co. for several years.

Beckman Erecting Jersey Plant

Beckman Instruments, Inc., South Pasadena, Calif., manufacturer of industrial control equipment, has started construction of a new 20,000 sq. ft. building in Mountainside, N. J. The building is to be used as eastern sales and service offices for the company and as an eastern manufacturing facility for its subsidiary, Helipot Corp., makers of helical potentiometers, used in precision electronic equipment.

Delanium Plant Produces

Production of Delanium Carbon Corp.'s graphite heat exchangers began about November 15 last month, at the company's new Morton Grove, Ill. plant. In addition to its heat exchanger line, the plant will eventually manufacture Paragrid absorption and scrubbing towers and other graphite products for the chemical, metallurgical and process industries.

New Engineering Organization

Equipment & Controls Engineers, Inc., is the name of a new engineering organization specializing in the design and building of complete coordinated process controls. Walter F. Gieryk has been named presi-

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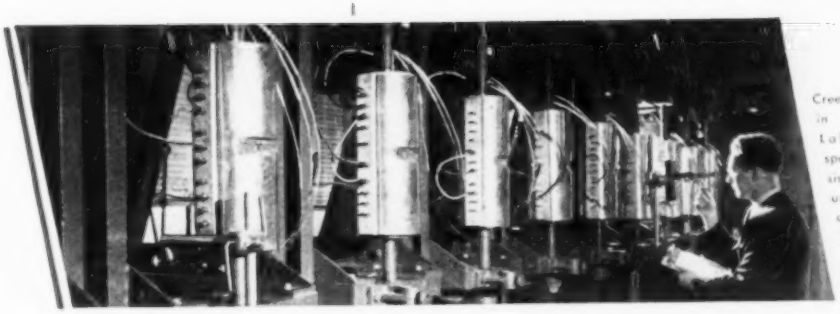

Creep tests under way in INCO's Research Laboratory. Here specimens of heat-resisting alloys are held under constant load at temperatures up to 2100°F.

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In a field that grows so fast, it is obviously impossible to have an immediate answer to every problem. But each new problem solved or studied adds to the total of knowledge on the subject. So if *you* are having high-temperature problems – whether in an existing application or with a new project, let the Inco Engineers work with you. Send for our High-Temperature Work Sheet, a simplified form to set out your full story. And you may find that Inco can suggest an answer to your problem.

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dent, and Mifflin S. Jacobs vice president. The new firm is located at 814 Noblestown Rd., Pittsburgh 5, Pa.

New Activated Carbon Plant

The Girdler Corp. has started operation of a new plant for producing activated carbon from hardwood charcoal and is planning to erect a completely new catalyst plant adjoining the carbon facilities.

The plant includes several new developments, part of a continuous process for manufacture of several types of activated carbon, and replacing older batch process. The carbon is used in desulfurization units and as a catalyst or a catalyst support in some other processes.

Personnel Changes

Oliver United Filters Inc.—Dwight Richards to director of engineering.

Lukens Steel Co.—W. Harrison Lackey to manager of plate sales. With the company since 1939, he moves up from post as plate sales specialist.

Watson-Stillman Co.—Robert S. Sweeney, from vice president and treasurer to vice president and general manager, hydraulic press division.

Blaw - Knox Construction Co.—Charles F. Hauck named assistant sales manager of the chemical plants division. In addition he will continue his duties as the division's manager of sales promotion.

General Controls Co.—B. L. Lerch from Chicago factory branch office manager to regional manager for the middle western territory. Russell Strongman to regional manager for eastern seaboard area.

Taylor Instrument Cos.—Rudolph G. Frank, from San Francisco sales branch to Denver to cover the territory from Denver to southern Idaho.

Expansion, Transition

Reliance Electric & Engrg. Co. has appointed Smithco Engineering, 3348 South Erie St., Tulsa, as sales representatives for Oklahoma.

Prengle, Dukler & Crump, recently organized consulting chemical and petroleum engineering partnership, have announced opening of offices at 1010 Dennis St., Houston.

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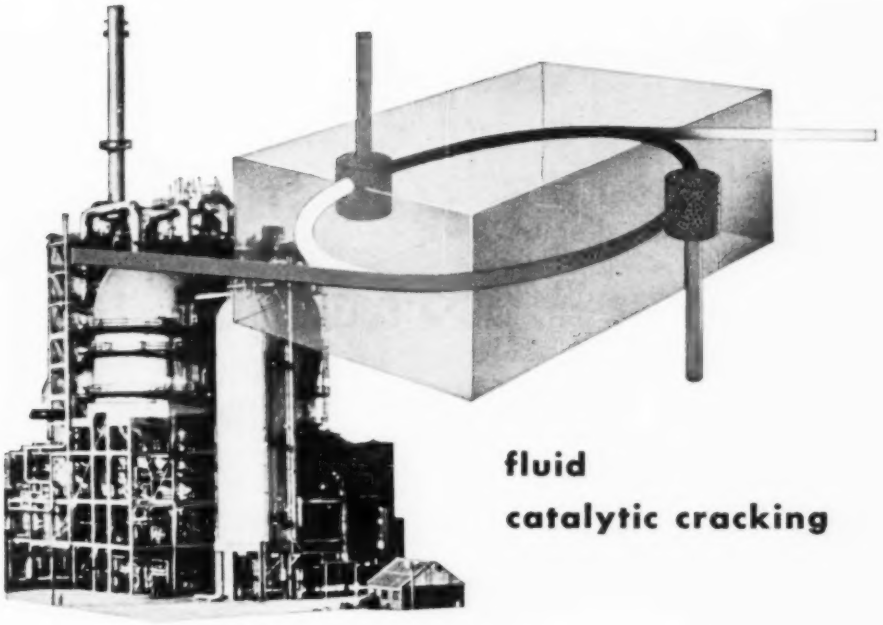

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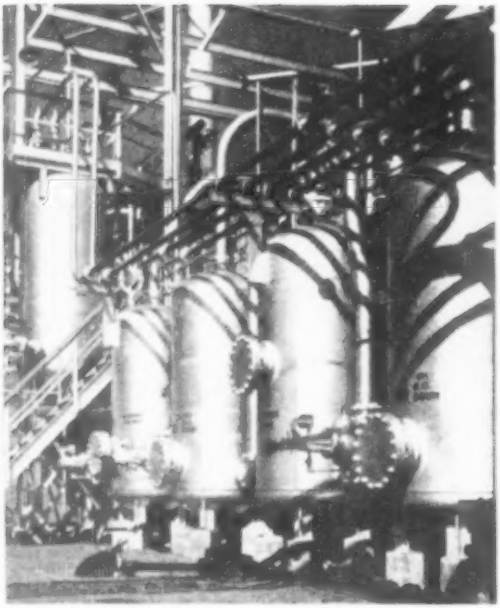

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Conciliation in Action—Principles and Techniques, by Edward Peters. xx + 266 pages. 6 x 9 in. Stiff cloth binding. Published by National Foremen's Institute, Inc., New London, Conn. $4.00.

"While I don't live by industrial relations, I sure as hell can die by them," a manufacturing vice president told Edward Peters, pointing up the important position they occupy in industry.

Mr. Peters is a California state conciliator who has participated in every major West Coast dispute involving the oil industry and labor since 1947 and has been active in major and minor labor disputes in other fields as well.

Mr. Peters examines the function of conciliators in collective bargaining and reviews the whole picture of labor-management negotiations from the standpoint of the neutral party. In so doing, he explains the fine points and techniques of this complicated business.

Classified as a "working manual", the book is aimed at company managers and supervisors, shop stewards, employe committeemen, union business agents and conciliators. It has been divided into two parts: "Dynamics of Industrial Strife" and "Conciliation Technique."

Random headings give an idea of points covered: short-term and long-term goals in the power conflict; three alternatives for breaking a deadlock; real vs. false pressure; conveying a position; human relations vs. business economics ("Labor relations is the art of finding the middle ground between them," writes the author); three requisites of a conciliator: experience, objectivity and impartiality.

Illustrative examples are drawn from actual but unidentified cases, including those involving oil industry negotiations. Mr. Peters writes in an easy style that makes for quick reading and comprehension.

F.B.

Investment Data Given On 20 Chemical Firms

Chemical Investments, by John F. Bohmfalk, Jr. 6 x 9 in. 87 pages. heavy paper cover. Chemonomics, Inc., 100 Madison Ave., New York 17, N. Y. $3.00.

An examination of twenty major chemical companies in relation to research and sales growth for major end-product groups is presented in this book with a discussion of management and research activities, and the individual outlook for each of the companies.

One interesting fact pointed out is that industry "is living beyond its income." The average chemical company is reported to have increased the percentage of debt and preferred stock from 22 to 30% in the post-war period. To balance this rise, convertible preferred stock has been sold accounting for 60% of all new post-war financing.

The author, John F. Bohmfalk, Jr., was formerly associate editor of *Chemical and Engineering News* and *Industrial and Engineering Chemistry*. More recently, he has specialized in investment analyses of chemical process industries for Clark, Dodge & Co., an investment firm.

ASTM Indexes Papers For 50-Year Period

Fifty Year Index to ASTM Technical Papers and Reports, 1898-1949. 6 x 9 in. viii + 207 pages. cloth binding. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $6.00.

This index provides a detailed author and subject index to all American Society for Testing Materials papers and reports dealing with materials, especially their properties and testing, appearing in ASTM publications from 1898 through 1950. The index is concerned basically with technical papers which have appeared in ASTM Proceedings, ASTM Bulletin, Special Technical Publications, or special compilations of standards. In addition, a number of technical reports have been referenced which, although not credited to specific authors, provide useful information on specific subjects. An author index precedes the subject index, and there is also a separate condensed subject index listing all ASTM technical symposia.

British Publish 1950 Technology Reviews

Reviews of Petroleum Technology, Volume 12 (Covering 1950), edited by George Sell. 6 x 9 in. viii + 343 pages. author and subject indexes. cloth binding. Institute of Petroleum, Maple House, 26 Portland Place, London, W. 1. Price: 2 pounds, 10 shillings.

Summarized information on all phases of the petroleum industry in 1950 is contained in this twelfth volume of technology reviews. There are over 3300 references to articles which appeared in the literature during that period.

Topics include: cracking and other petroleum processes; refinery plant and engineering (1948-50); chemistry and physics of petroleum; engine testing of fuels and of lubricants (1949-50); natural gas; liquefied petroleum gases; natural gasoline; gasoline and light distillates; diesel fuels; lubricants; oils from coal and other materials; and corrison.

Reference is made to the "Oxyl" process for making primary alcohols from C_1 to C_{20} directly from synthesis gas; also to the U. O. P. process for making ethylene by burning ethane with air; and to Shell Oil's manufacture of acrolein by the catalytic oxidation of propylene, which has halved the price of the commodity.

Significance of Lead (Pb) Found In Its New Uses

Lead In Modern Industry. 6 x 9 in. viii + 230 pages. indexed. stiff cloth binding. Published by Lead Industries Assn., 420 Lexington Ave., New York 17, N. Y. $1.50 postpaid.

Subject matter of this book is devoted exclusively to the manufacture, applications and properties of lead, lead alloys and lead compounds. Divided into 28 chapters, the book begins with the history of lead, its production from mine to refined metal, and a detailed description of the various techniques for fabricating the metal into useful form. Separate chapters are devoted to the more important uses for lead including cable sheathing, chemical construction, plumbing, coatings, bearing metals, and a variety of others.

Corrosion resistance of lead and its alloys and methods of using them for chemical construction are fully detailed along with the techniques for joining lead by soldering or welding. Some of the more complex operations are illustrated with both drawings and photographs.

Included are the latest specifications for lead, lead alloys and lead products, and the physical constants of organic and inorganic lead compounds.

Manual Aids Engineer In Metals' Selection

Engineering Materials Manual, edited by F. C. DeMond. 8½ x 11½ in. 348 pages. illustrated. stiff cloth binding. Reinhold Publishing Corp., 330 W. 42nd St., New York 36, N. Y. $5.00.

Comprising 28 sections, this volume gives descriptive information on a variety of engineering materials covering a variety of industries. Included are section on irons, steels, stainless steels, aluminum, magnesium, copper alloys, plastics, rubber, ceramics, several types of finishes and coatings. One section aids in the proper selection of sleeve bearings, with a description of the various alloys available commercially which are used in the manufacture of specific type bearings.

Processing and service characteristics of standard engineering steels are given concisely in the book's opening pages. Charts and graphs are neatly presented, and photographs

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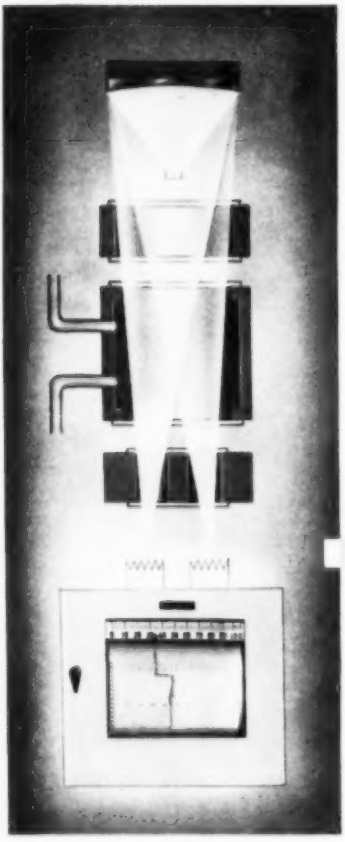

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Books

throughout are sharp and convey the meaning of the particular section they are identified with.

The book was edited by T. C. DuMond, editor of *Materials and Methods*, a Reinhold publication.

Chemical Kinetics Tabled In Government Circular

Tables of Chemical Kinetics, Homogeneous Reactions, National Bureau of Standards Circular No. 510, presented as a cooperative effort sponsored by the National Bureau of Standards, the Committee on Table of Constants of the National Research Council, and Princeton University, XXIV + 731 pages.

Copies of this circular can be ordered for four dollars from the Government Printing Office, Washington 25, D. C.

Books Received . . .

Chemistry of Carbon Compounds, Vol. 1, Part B, Aliphatic Compounds, edited by E. H. Rodd. 6 x 9 in.; xii + 683 pages (799-1462); indexed; stiff cloth binding. The Elsevier Press, P. O. Box 6175, Houston 6, Texas. Price, $15.00 to subscribers, $17.50 list.

Encyclopedia of Surface-Active Agents, by J. P. Sisley and P. J. Wood. (Over 2,500 Commercial Brands from Acidol to Zitrofol). 6 x 9 in.; ix + 540 pages; stiff cloth binding. The Chemical Publishing Co., 26 Court St., Brooklyn 2, N. Y. $15.00.

Weldability of Metals, Reprinted from Ninth Edition Procedure Handbook of Arc Welding Design and Practice. 5½ x 8½ in.; 142 pages, paper cover. The Lincoln Electric Co., Cleveland 17, Ohio. Price, 50 cents.

Association Publications

Appraisal of Several Methods of Testing Asphaltic Concrete, Bulletin 126, June 1952, by Fred J. Benson. 6 x 9 in.; v + 81 pages, paper cover. Address inquiries and requests for publications to the Texas Engineering Experiment Station, The Texas A. and M. College System, College Station, Texas.

Standards for the Installation of Containers and Pertinent Equipment for Liquefied Petroleum Gases, Pamphlet 58, National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass.

Radioactive Atoms and Isotopic Tracers, Twenty-Sixth Annual Pittsburgh Lecture, by Joseph W. Kennedy. 8½ x 11 in.; 89 pages, heavy paper cover. Phi Lambda Upsilon, Department of Chemistry, The Pennsylvania State College, State College, Pa. $2.00.

Government Publications

Petroleum Refineries, Including Cracking Plants In The United States, January 1, 1952, Bureau of Mines Information Circular 7646, by J. G. Kirby. 8 x 10½ in.; 12 pages, paper cover. Can be ordered free from the Publications Distribution Section, U. S. Bureau of Mines, 4800 Forbes St., Pittsburgh 13, Pa.

Removal of Hydrogen Sulfide and Carbon Dioxide from Synthesis Gas Using Di- and Tri-Ethanolamine, Report of Investigations 4891, by H. W. Wainwright, G. C. Eglesson, C. M. Brock, J. Fisher and A. E. Sands. 8 x 10½ in.; ii + 19 pages, illustrated, heavy paper cover. Can be ordered free from Publications Distribution Section, U. S. Bureau of Mines, 4800 Forbes St., Pittsburgh 13, Pa.

A Quarter Century of Fuel-Oil Sales, 1926-50, Bureau of Mines Information Circular 7630, by A. T. Coombe and I. F. Avery. 8 x 10½ in.; iii + 100 pages, paper cover. Can be ordered free of charge from the U. S. Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

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Remember the legend of Damocles? His tyrant ruler compelled him to sit in the royal court for one day with a naked sword suspended over his head by a single hair.

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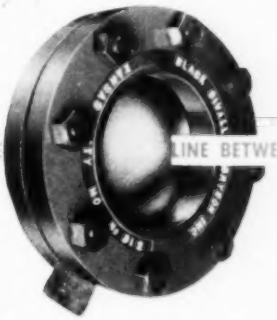

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Fuels and Lubricants Sessions Set For Final Day of SAE Meeting

OBTAINING high gasoline mileage will be discussed by W. S. Mount, Socony-Vacuum Oil Co., at the Society of Automotive Engineers annual meeting in Detroit which is being held January 12-16, 1953. Mr. Mount will deliver his paper, "The Economy Run — Par for Gasoline Mileage," on Friday, January 16, in the Sheraton-Cadillac Hotel's Grand Ballroom at 9:30 A. M. The paper will be delivered under the sponsorship of the Fuels and Lubricants Committee. J. G. Moxey, Jr., Sun Oil Co., will be the presiding chairman. F. C. Burk, Atlantic Refining Co., will handle the committee's secretarial matters.

C. R. Johnson and D. N. Harris, Shell Oil Co., will also address the Fuels and Lubricants session on January 16, on "Service Experience with TCP Fuel Additive." D. R. Diggs, E. I. du Pont de Nemours and Co. Inc., will present by title, "The Effect of Combustion Time on Knock in a Spark-Ignition Engine."

"A Method for Identifying Preignition" will be delivered at 2:00 P. M. January 16, by R. F. Winch and F. M. Mayes, Sun Oil Co. This paper will follow presentation of the Horning Memorial Award to L. F. Dumont by J. R. Sabina, Chairman, Horning Memorial Board of Award. The final paper of the Fuels and Lubricants session will be "A Low Temperature Sludging Test," by J. G. McNab, M. E. Conn, D. S. McArthur, and K. L. Stohle, Esso Laboratories, Standard Oil Development Co.

Other program events of interest include:

Tuesday, January 13—9:30 A.M.
Grand Ballroom

Business Session of Engineering Materials Activity

Symposium: Wear and Surface Treatments to Prevent Wear

"The Mechanics of Wear," by W. E. Jominy, Chrysler Corp.

Lubricants—"The Surface Savers," by J. F. Kunz, Jr., and J. P. Hamer, Esso Laboratories, Standard Oil Development Co.

Tuesday, January 13—8:15 P. M.
Grand Ballroom

Business Session of Production Activity

"The Future of Atomic Energy in Industry," by W. L. Cisler, Detroit Edison Co.

Oil Man's Calendar

1953

JANUARY

Midwest Research Institute, symposium on the Place of Automatic Computing Equipment in Industry, Kansas City, Mo. Jan. 5-6.

Society of Automotive Engineers, annual meeting and engineering display, Sheraton-Cadillac Hotel, central office, Jan. 12-16.

American Chemical Society and **The American Institute of Chemists**, New York Section, Symposium on Public Relations for Chemists, Hotel Commodore, New York, N. Y. Jan. 15.

Fourth Plant Maintenance Show, Public Auditorium, Cleveland, Ohio, Jan. 19-22.

American Society for Testing Materials, Committee D-19 on Industrial Water, St. Louis, Mo. Jan. 26-28.

A. and M. College of Texas, Symposium on Instrumentation for the Process Industries, Memorial Student Center, College Station, Texas, Jan. 29-30.

FEBRUARY

National Assn. of Corrosion Engineers, five-day short course in corrosion in cooperation with University of California's extension department and departments of mechanical engineering, metallurgy and chemical engineering, Berkeley, Calif. Feb. 2-6.

Western Computer Conference, sponsored jointly by Computer Conference Committee of the Institute of Radio Engineers and the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif. Feb. 4-6.

Western Petroleum Refiner's Assn., regional meeting, Rice Hotel, Houston, Texas, Feb. 12-13.

Instrument Society of America, New York Section, 4th annual regional meeting, Hotel Statler, New York, N. Y. Feb. 18.

Natural Gasoline Assn. of America, regional meeting, Southwest Hotel, Midland, Texas, Feb. 23.

MARCH

American Society for Testing Materials, fifth meeting and Committee Week, Hotel Statler, Detroit, Mich. Mar. 2-6.

American Society for Testing Materials, Committee E-14 on Mass Spectrometry, Pittsburgh Conference, Pittsburgh, Pa. Mar. 2-7.

American Institute of Chemical Engineers, Metal-Xylol Hotel, Bloomington, Ill. Mar. 5-11.

National Assn. of Corrosion Engineers, 9th Annual Conference & Exhibition, Hotel Sherman, Chicago, Ill. Mar. 16-20.

Western Petroleum Refiners Assn., annual meeting, Plaza Hotel, San Antonio, Texas, Mar. 23-25.

American Society for Metals, Eighth Western Metal Congress and Exposition, Pan-Pacific Auditorium, Los Angeles, Calif. Mar. 23-27.

APRIL

Natural Gasoline Assn. of America, 32nd annual convention, Rice Hotel, Houston, Texas, Apr. 29-May 1.

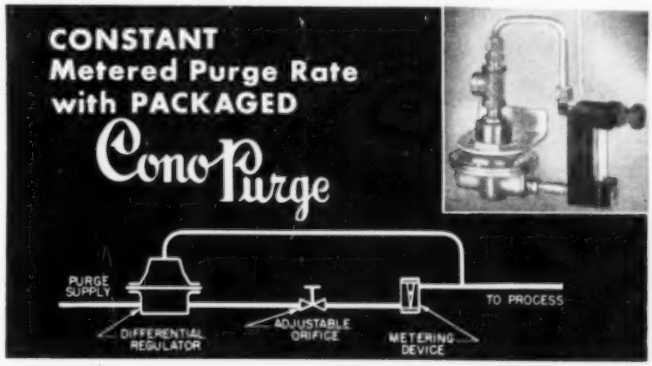
MAY

American Petroleum Institute, Division of Refining, mid-year meeting, Hotel Commodore, New York, N. Y. May 11-14.

International Petroleum Exposition and Congress, Hall of Science, Palais Onio, May 14-23.

Maintenance Show Lists Round Table Discussions

A ROUND table discussion on "Maintenance in Petroleum Refining Plants," will be held Tuesday, Jan. 20 at Cleveland's Public Auditorium during the four-day Plant Maintenance Conference. Discussion leader is J. G. Traxler, assistant superintendent of maintenance and construction at Humble Oil & Refining Co.'s Baytown refinery. Stuart Whitehead, general superintendent of the maintenance and construction department, Calco Chemical Div., American Cyanamid Co., is discussion leader on a similar panel for "Maintenance in Chemical Plants," also scheduled on Tuesday.



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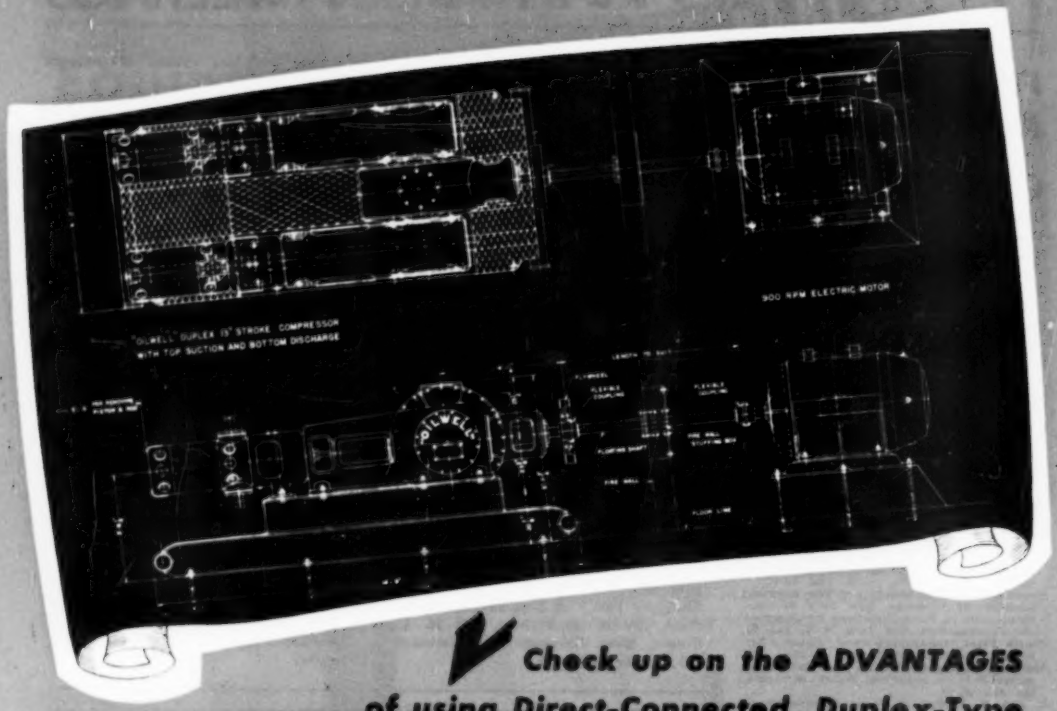

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Heating Oils Reach Nov. 1 Peak 5% Greater Than a Year Ago

PRIMARY stocks of heating oils (kerosine and distillate fuels) in the U. S. reached a record figure of nearly 154,000,000 bbls. Nov. 1, 5% larger than on Nov. 3, 1951. Forecasts of increases in demand for heating oils this winter range from 5% to as high as 9%. While, statistically, the increase in stocks may not have kept up with the gain in demand, this is offset by the current high rate of refinery production of distillate fuels, which for the past few months has been 10% or more greater than in the same period in 1951.

The buildup in kerosine and distillate stocks this year since March 29 has been 94,000,000 bbls. and compares with a buildup of a little better than 84,000,000 bbls. in the corresponding period in 1951. However, the growth in inventories this year has also made up for the loss of about 16,500,000 bbls. of refinery output of kerosine and distillates during the strike of refinery workers in May. To make up for this loss, refinery output since June and the resulting gain in stocks, has been at a much higher rate than in 1951. This high rate of operations continued through November.

The total volume of heating oil stocks to start the winter reflects the drop in the production of kerosine this year in most refinery districts. While total heating oil stocks are 5% larger than at the start of November last year, the gain in distillate stocks alone over the country is nearly 9%. Stocks of kerosine, however, are 6% lower than on Nov. 3, 1951. Kerosine stocks are less than a year ago in all except the East Coast and Okla.-Kans.-Mo. districts. In the Gulf Coast district kerosine inventories are 29% less than the year previous and in California they are over 40% less. See Table 1 for details of stock changes in heating oils.

East of California heating oil stocks Nov. 1 were 3% larger than on Nov. 3, 1951. In the East Coast district inventories were 7% larger. In the two Gulf Coast districts, principal source of supply for the northeastern heating oil market, stocks were 5% lower. Heating oil inventories in the Okla.-Kans.-Mo. district were 12% larger and in the Ind.-Ill.-Ky. district about the same as a year ago. California stocks were 32% larger, despite the drop in kerosine stocks, reflecting a 36% gain in distillate stocks.

Secondary stocks of heating oils, now being reported regularly as a service of the Census Bureau, showed about 31,500,000 bbls. (8,336,000 of kerosine and 23,216,000 of distillates) in the tanks of local distributing agencies on Sept. 30. This was nearly 3,000,000 bbls. more than was reported for Aug. 31. The total this year was about 1,500,000 bbls. larger than on Sept. 30, 1951.

Gasoline stocks at refineries reached their seasonal low point in the Nov. 1 report, 120,563,000 bbls., comparing with 119,563,000 bbls. on Nov. 3, 1951. The indicated rate of buildup in the first three weeks of November was about 1,000,000 bbls. larger than in the first three weeks in November a year ago. The reduction in stocks this year was around 32,250,000 bbls. from the high point of 158,800,000 bbls. on March 29. This net withdrawal for the season is about the same amount as drafts on refiners' stocks in May to make up for loss of production during the strike. The rate of refinery output, starting in June, has been great enough to take care of the high seasonal demand and even allow a small addition to stocks. The indicated rate of motor fuel supply in November is around 9% larger than in November, '51, while the rate of supply for 10 months is only about 4% greater than last year.

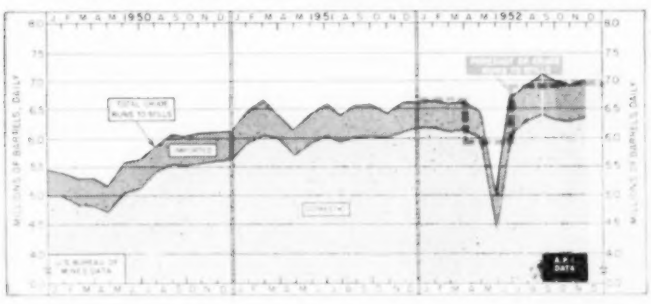
Residual fuel oil stocks on Nov. 22 were 52,081,000 bbls. in the U. S., nearly 3,400,000 bbls. higher than the 48,700,000 bls. in refiners' storage on Nov. 24, 1951. East of California inventories this year are about 1,000,000 bbls. lower, while California stocks were nearly 4,300,000 bbls. higher than in early November a year ago. Indicated residual fuel oil demand is about 7% less than in the late fall of 1951 and demand for 10 months is 3% less.

Table 1—Refiners' Stocks of Heating Oils, by Refining Districts, Nov. 1, 1952 and Nov. 3, 1951

(1000 Bbls. Revised API Data)

	Kerosine			Distillates			Total Heating Oils		
	Nov. 1 1952	Nov. 3 1951	% Change	Nov. 1 1952	Nov. 3 1951	% Change	Nov. 1 1952	Nov. 3 1951	% Change
East Coast	14,980	13,761	+ 9	43,619	41,005	+ 6	58,599	54,766	+ 7
Gulf Coast	6,389	8,955	- 29	19,378	18,193	+ 6	25,765	27,148	- 5
Total Coastal	21,369	22,716	- 6	62,995	59,198	+ 6	84,364	81,914	+ 3
Appalachian	875	1,159	- 27	2,534	1,917	+ 32	3,409	3,116	+ 9
Ind.-Ill.-Ky.	7,436	7,852	- 5	22,321	22,328	- 1	29,957	29,980	- 0
Okla.-Kans.-Mo.	2,167	2,042	+ 6	12,501	11,302	+ 11	15,668	14,027	+ 12
Other Inland	1,614	1,768	- 10	5,921	5,391	+ 10	7,535	7,160	+ 5
Total East of Cal.	33,461	35,537	- 6	107,272	100,529	+ 6	140,733	136,227	+ 3
California	266	568	- 41	12,805	9,293	+ 38	13,104	9,861	+ 32
TOTAL U. S.	33,760	35,904	- 6	120,077	110,224	+ 9	153,837	146,128	+ 5

Fig. 1—Crude Runs Hold at 7,000,000 Bbls.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MILLIONS OF BARRELS DAILY
TOTAL CRUDE RUNS TO STILLS
API DATA
U.S. BUREAU OF MINES DATA

Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
Nov. '52 API*	6,968	637	7,605
Nov. '51 BM	6,149	460	6,609
Change	+ 819	+ 177	+ 996
% Change	13.3	38.5	15.0

* Through Nov. 22

Total (1000 bbls.)

(Bureau of Mines Data)

10 Mos. '52*	1,846,675	168,420	2,014,835
10 Mos. '51	1,811,986	154,328	1,966,314
Change	+ 34,423	+ 14,292	+ 48,721
% Change	1.9	9.2	2.4

* Estimated from API data

BM Forecast of Crude Runs to Stills, 1952

(Bureau of Mines Data)

	Domestic	Foreign	TOTAL
1st Q.	6,801	564	7,365
2nd Q.	7,318	514	7,832
3rd Q.	7,400	515	7,915
4th Q.	6,970		

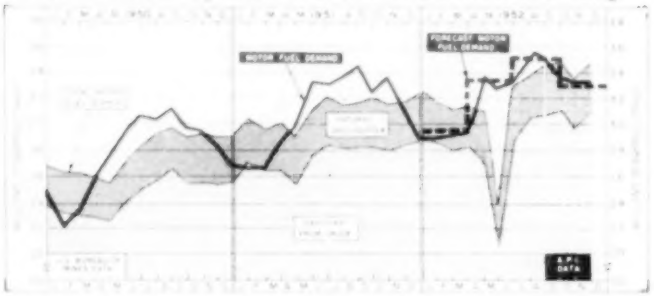
Yields on Crude Runs to Stills

	Gasoline	Kerosine	Distillate Fuels	Residual Fuels
	%	%	%	%
Nov. '52 API*	44.1	4.4	29.7	17.8
Oct. '52 API	43.5	4.5	29.5	17.5
Nov. '51 BM	47.3	4.9	29.3	17.4
Nov. '52 BM	42.6	4.1	30.4	19.6

* Through Nov. 22

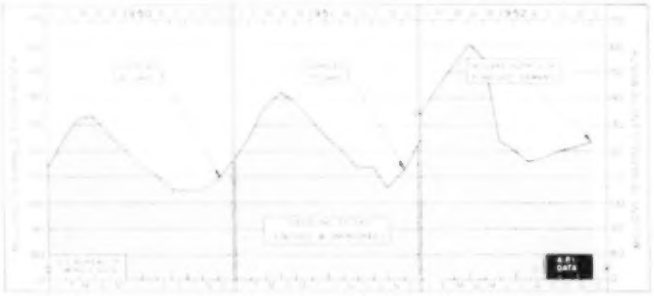
UNITED STATES STEEL

Fig. 2—Refinery "Gas" Demand Continues Strong



*Natural Gas Liquids include gasoline blended at refineries, and that used as finished motor fuel.

Fig. 3—Slow Buildup in Gasoline Stocks



*New basis for reporting added approximately 9,000,000 bbls. to primary stocks.

Fig. 4—Normal Seasonal Heating Oil Demand

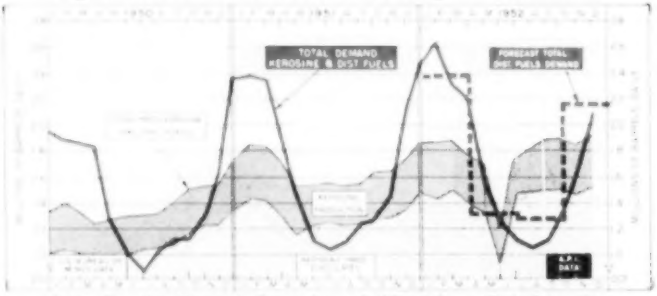
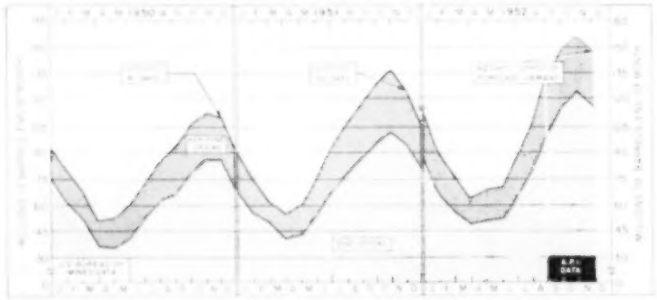


Fig. 5—62 Days' Supply of Heating Oil Stocks



*New basis for reporting added approximately 4,500,000 bbls. to primary stocks.

Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
Nov. '52 API*			
Nov. '52 BM			
Change			
% Change			
* Revised Nov. '52			

Total (1000 bbls.)

10 Mos. '52*			
10 Mos. '51			
Change			
% Change			

*Revised, estimated from API data.

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

Nov. '52 API*	
Nov. '52 BM	
Change	
% Change	
* Revised Nov. '52	

Total (1000 bbls.)

10 Mos. '52*	
10 Mos. '51	
Change	
% Change	

*Revised, estimated from API data.

BM Forecast of Motor Fuel Demand, 1952

Actual											
Forecast											

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

Nov. '52 API	
Oct. '52 API	
Nov. '52 BM	
Nov. '51 BM	
Nov. '52	

Heating Oils Production

(Kerosine and Distillate)
Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
Nov. '52 API*			
Nov. '52 BM			
Change			
% Change			
* Revised Nov. '52			

Total (1000 bbls.)

10 Mos. '52*			
10 Mos. '51			
Change			
% Change			

*Revised, estimated from API data.

Heating Oils Demand

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
Nov. '52 API*			
Nov. '52 BM			
Change			
% Change			
* Revised Nov. '52			

Total (1000 bbls.)

10 Mos. '52*			
10 Mos. '51			
Change			
% Change			

*Revised, estimated from API data.

BM Forecast of Heating Oils Demand, 1952

Actual											
Forecast											

Heating Oil Stocks

(1000 bbls. end of month)

	Kerosine	Dist. Fuels	TOTAL
Nov. '52 API*			
Oct. '52 API			
Nov. '52 BM			
Nov. '51 BM			
Nov. '52			
* Nov. '52			

Fig. 6—Strong Pickup in Residual Demand

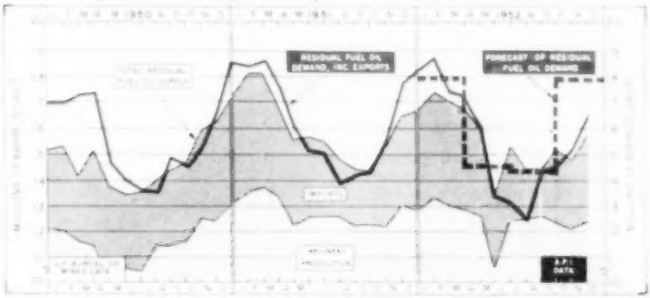
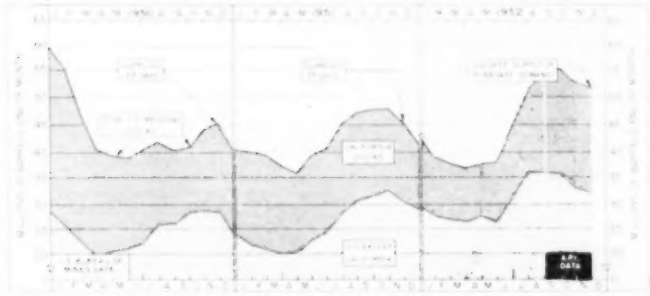


Fig. 7—Moderate Drop in Residual Stocks



*New basis for reporting added approximately 1,500,000 bbls. to primary stocks.

Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
1951			
1952			

Total (1000 bbls.)

1951			
1952			

Residual Fuels Demand

Daily Average (1000 bbls.)

1951	
1952	

Total Demand (1000 bbls.)

1951	
1952	

BM Forecast Residual Fuels Demand, 1952

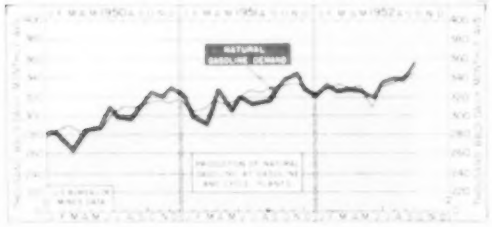
1952			

Residual Fuel Stocks

(000 bbls. end of month)

	U.S. Except California	TOTAL U.S.
1951		
1952		

Fig. 8—Supply and Demand of Natural Gas Liquids



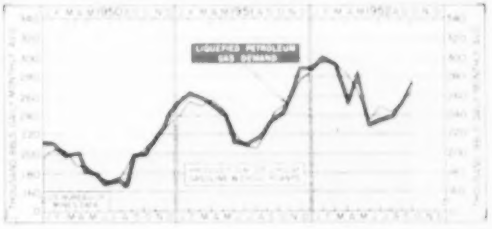
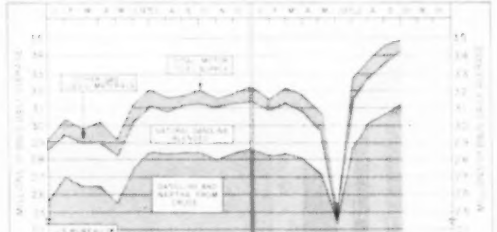


Fig. 9—Makeup of U.S. Motor Fuel Supply



(Figures in table in 1000 bbls./day average)

	Gasoline & Naphtha from Crude	Natural Blended	Other Gas Liquid Materials	Total Motor Fuel Supply
1951				
1952				

Natural Gas Liquids Statistics

Supply (1000 bbls./day avg.)

	Natural Gasoline	LPG	TOTAL
1951			
1952			

Total Supply (1000 bbls.)

1951	
1952	

Demand (1000 bbls./day avg.)

	Natural Gasoline	LPG	TOTAL
1951			
1952			

Total Demand (1000 bbls.)

1951	
1952	

Stocks, End of Month (1000 bbls.)

	By type of product (At gasoline plants and terminals only)			By Location		
	LPG	Natural Gasoline	Cor. Distillate	Finished Gasoline*	Gasoline Plants	Refineries	Total
1951							
1952							

ADVERTISERS' INDEX

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

●

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card . . . no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

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(K-2) ALLIED CHEMICAL & DYE CORP., SOLVAY PROCESS DIV. 1830
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(A-4) ALLOY STEEL PRODUCTS CO. 1753
(A-5) ALUMINUM CO. OF AMERICA (Chemicals Div.) 1801
(A-6) ALUMINUM CO. OF AMERICA (Distributor) 1828
(A-7) AMERICAN CYANAMID CO. 1745
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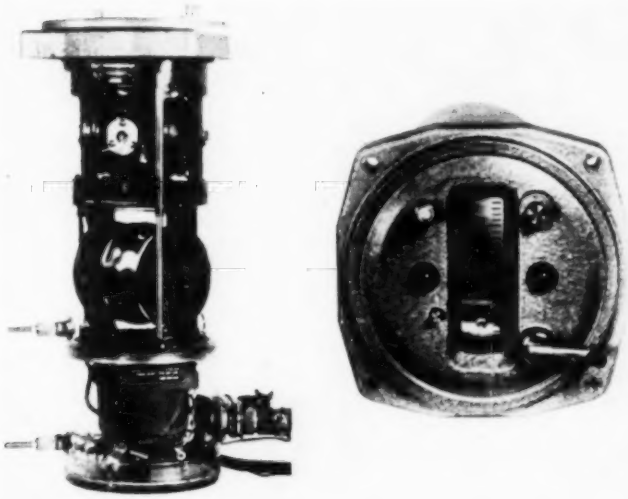
(L-6) WRIGHT CHEMICAL CORP. 1846
(L-7) WYATT METAL & BOILER WORKS Outside Back Cover

WHAT'S NEW . . .



50 FEET OF 35-MM. FILM provides a precise scale for meter in which . . .

Pressure Accuracy Is 1 in 5000

A new pressure-measuring instrument is said to be as accurate as the most sensitive mercury manometer but more rugged and convenient to use. Called the "Press-I-Cell," the device can measure pressure with an accuracy of one part in 5000, and has a sensitivity of 1 in 15,000. The unit measures 14 in. in length by 5 in. in diameter, is portable, temperature-stable, and unaffected by vibration or mounting positon.

A 600-in. scale, with easily-read intervals of 1/16 in. representing 1/10,000 of the full pressure range, provides accuracy. The scale, printed on a 35-mm. film strip, is said to be virtually unaffected by temperature or humidity changes, the reading portion being held to constant length by a pair of winding sprockets two inches apart. Sprocket movement is synchronized with the action of the pressure follow-up system. Scale readings are made on this section with a hairline on a transparent window in the case (see view at right in the photograph).

Typical pressure ranges for which the instrument is equipped are 1 atm. absolute, 400-in water column, and 150-in. Hg. differential. Either of two models is available: manual, in which proper scale position is found by manual setting; and automatic, in which scale is positioned correctly by a servomotor. In the latter type, correct reading is obtained with no hunting or oscillation of the scale. Repeatability is rated at 1 in 700. View at the left shows internals (transparent case used and film scale removed for photo purposes). Top of the instrument (view at right) is the only part exposed when it is panel-mounted.

The manufacturer emphasizes that the Press-I-Cell is not intended to replace standard instruments used in usual applications where extreme accuracy is not required. Suggested applications, rather, include: a master laboratory instrument for calibration; a precision device for altitude or barometric pressure; a liquid level gage for large storage tanks; field tests requiring high precision or sensitivity with a compact test gage. Fischer & Porter Co., Hatboro, Penna.

Circle No. 1 on Reply Card

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.

Insulating Type Firebrick Offers Possibilities of Savings in Fuel

An insulating firebrick, made of vermiculite and clay binders, has very low thermal conductivity which prevents excess heat loss in either constant or intermittent furnace operation and offers savings in fuel costs. Vermiculite is a micaceous mineral providing the insulation quality. Bricks are said to have high resistance to cracking from impact or thermal shock, have physical and chemical stability within their temperature range, and can be sawed and fitted without breakage. They are designed primarily as back-up insulation for refractory brick in the service range up to 1800° F. When not subjected to mechanical abrasion or exposed to molten slag or metal they can be used as facing brick in the same range. Physical properties, in addition to temperature range, are: density, 35 lb./cu. ft.; thermal conductivity, 1.25 at 700° F. mean; cold crushing strength, 185 psi.; modulus of rupture, 145 psi.; linear shrinkage after reheating to 1600° F., 0.1%; linear shrinkage after reheating to 1800° F., 2.0%. Bricks are made in standard nine-inch series. Any good refractory mortar can be used. Zonolite Co., Chicago, Ill.

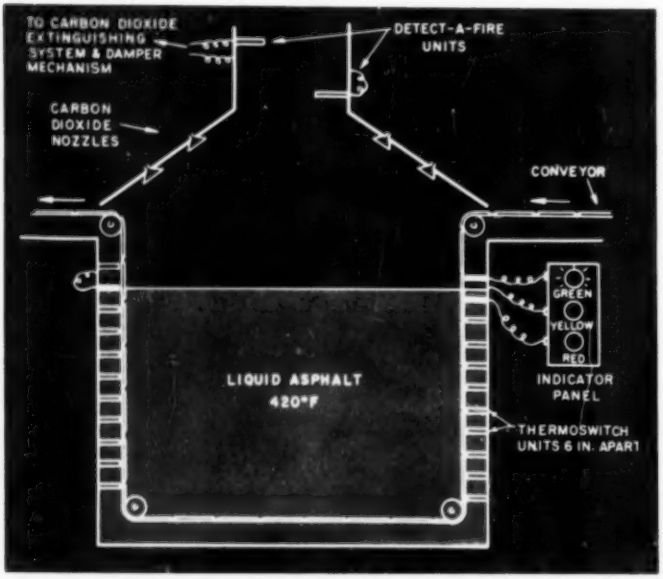
Circle No. 2 on Reply Card

Semi-Rigid Butyrate Plastic Pipe Developed for Petroleum Uses

A new line of plastic pipe—in flexible and semi-rigid types—will soon be in production and available on the market. The semi-rigid-type made of butyrate plastic, is expected to find its best applications in petroleum because it is not affected by paraffin crudes, raw gas, sour crudes, or brine. It will come in ½ to 6 in. diameters in 20-ft. lengths with one coupling cemented. Its chemical resistance is expected to make it useful in chemical processing piping. The flexible type will be made of polyethylene and will come in three styles: non-toxic—for uses in foods; industrial — for chemical uses including acids, alkalis, soaps, and detergents; and suction—for higher pressures in larger sizes. It will be furnished in coiled form. Triangle Conduit & Cable Co., Inc., New Brunswick, N. J.

Circle No. 3 on Reply Card

What's New!



Thermostats Measure Liquid Level

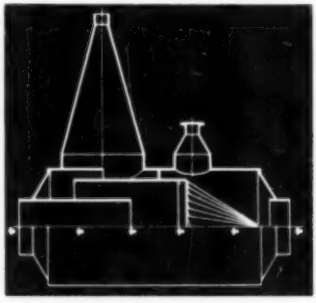
Thermostats have been used to solve a problem of continual check on a liquid level controller in a hot asphalt tank and a visual alarm in case the controller fails. The thermostats were adopted because the high temperature and viscosity of the asphalt interferes with the operation of many level indicators. The scheme was devised by engineers at the Flintkote Co. for use in a 15-ft. deep dip tank in which insulated siding is saturated with liquid asphalt at about 420° F.

As shown in the drawing, two rows of thermostatic switch units, each with 11 units spaced six in. apart, are mounted on opposite walls of the tank. The rows are staggered vertically so that level is measured at three-inch intervals. The thermostats are connected to a set of three pilot lights. By means of prong-type connectors, any three thermostats can be connected to the three pilot lights, depending on which level is required for a particular operation.

The "Thermoswitch" units follow the liquid level by responding to the asphalt temperature, and are set at about 375° F. to operate the pilot light circuits. In the set of three lights, a red one indicates lowest allowable level, a yellow, safe level, and a green, highest allowable level. Switch units used in the installation are of the type which could also be used in a circuit to cut off a pump if desired.

The asphalt installation also uses, for safety purposes, an automatic carbon dioxide fire extinguishing system, actuated by "Detect-A-Fire" units, made by the manufacturer of the Thermoswitches: Fenwal, Inc., Ashland, Mass.

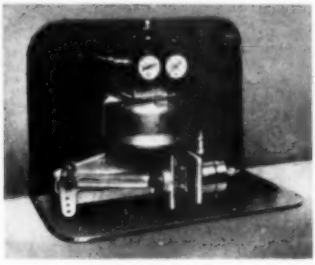
Circle No. 4 on Reply Card



New Centrifugal Separator for Catalysts Has High Efficiency

A new centrifugal separator for catalytic dust has been introduced in two basic designs — one for use within cracking process vessels, and the other for service in lines or ducts. Test results have been obtained of over 95% separation efficiency at relatively low loadings on catalyst dust passed by an electrostatic precipitator, composed of particles less than 40 microns in size. Loadings approaching those in refinery practice will produce an increased efficiency due to agglomeration, according to the manufacturer. In the external design (see drawing), the shell through which the gas flows is in a horizontal position. The patented tuyere gives the total mass of gas carrying the dust a rotary motion so that particles are carried to the outer periphery and discharged against the walls, and then collect in the hopper. Separators for use inside large vessels are basically the same, but comprise groupings of shell barrels around a central outlet with a hopper bottom. Separators are constructed of alloy, with shell and hopper lined of ceramic clay reinforced with hex steel mesh. Centrifix Corp., 3608 Payne Ave., Cleveland 14, Ohio.

Circle No. 5 on Reply Card



Low Flow Control Valve Can Work at up to 50,000 psi

"Wee Willie" is a new high pressure, low flow control valve. The valve is pneumatically controlled and is specifically adapted to pilot plant operation. Standard models are available with working pressure ranges of 10,000 and 30,000 psi, with special assemblies up to 50,000 psi. Sizes range from $\frac{1}{8}$-in. through $\frac{1}{2}$-in. with screw, welding, superpressure, and autoclave end connections available. A simple combination of four interchangeable plugs and two seat rings provides a C$_v$ selection of values from .0016 to 1.00. Flow characteristics are normally linear. The Wee Willie valve assembly features travel limit stops with built-in reversing arrangement for changing from air-to-open and air-to-close. Basic valve body material is Types 304, 316 or 347 stainless steel with D-20, Nickel, Monel, Hastelloy, or any of the other available alloys on special order. Auxiliary equipment includes cooling fins for temperatures from −430° to 1200° F. service, and bellows seal for outlet working pressures to 3,000 psi. The Annin Co., Los Angeles, Calif.

Circle No. 6 on Reply Card

Electronic Color Alarm Stops Need of Rerunning Kerosine

The Hallikainen-Shell Development Color Alarm is a differential type colorimeter giving an alarm or a visual signal when the preset color has been exceeded. It has already been used successfully for controlling the color of kerosine and preventing rerunning. Theory of operation is as follows. A low-powered electric lamp provides a light source, a part of which traverses the sample cell and is reflected to again pass through the cell and fall on a small phototube. A second tube as a reference receives light from the same source. Quantity of light reaching the reference tube is adjusted by a knob-pointer-scale on the instrument case which regulates a shield with a wedge-shaped opening between the light beam and the reference tube. Liquid of a darker color flowing through the sample cell unbalances the circuit, energizing or de-energizing the signal light, as the case may be. Spare relay contacts are included for an audible alarm if it is desired. Instrument is stable to about 1/10 of a Union color number on kerosine under usual line voltage fluctations. However, sensitivity can be increased if needed. Two models are available—explosion-proof and standard. Case dimensions are 7 x 6 x 13 in. Other models are available for continuously indicating and recording color. Hallikainen Instruments, 1341 Seventh St., Berkeley, Calif.

Circle No. 7 on Reply Card

16-Station System Designed for Ultrasonic Viscosity Recorder

A multiple-probe system for continuous automatic viscosity measurement by the new ultra-sonic device announced last spring (What's New! Item 6, May, p. 698) has now been developed. The Model MP multi-probe Ultra-Viscoson system operates at up to 650° F. and 1000 psi. for a total of 16 stations. Probes can be located as far as one mile from a central computer station where viscosities are recorded automatically in whatever order desired. Heart of system is the small metal probe which is inserted into the liquid and is excited by an ultrasonic generator. The probe's oscillations are dampened as a direct function of the viscosity, unaffected by flow variations. The damping effect is measured and the result fed through a small electronic analog computer to an indicator or recorder calibrated to read direct in viscosity values. Ultra-Viscoson Corp., 1240 Main St., Hartford 3, Conn.

Circle No. 8 on Reply Card

Flow Meter Handles 100 gpm Of Corrosives at 125 psi

A new "2 BC Rotocycle Stainless Steel Industrial Meter" has been developed to handle corrosive liquids. The meter has a maximum capacity of 100 gpm at a working pressure of 125 psi. All parts of the meter which come in contact with corrosive liquids are made of stainless steel. Accessories available with the meter are: 1) a remote register, which provides for transferring the reading of the meter register by electrical impulses to a central control room, remote from the point where actual measurement takes place; 2) a quantity control register with a built-in electric switch that is actuated after a predetermined volume of liquid has passed through the meter; 3) swivel adapters; and 4) register extensions. Weight of the meter without accessories is 120 lbs. Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Circle No. 9 on Reply Card

DID YOU MISS THESE?

The following items, reviewed originally in the October issue, have aroused considerable interest. They are repeated briefly as a service to those who might have missed them the first time. For details or literature, use the regular Reply Card in this issue.

New Bubble Tray Design

Turbogrid Distillation Trays by Shell Development Co.; an eight-page brochure with technical and engineering information on a new fractionation tray designed for higher capacity at equal separation, lower pressure drop, long tray life, and easier maintenance; consisting simply of a series of transverse bars or slots. Shell Development Co., 50 West 50th St., New York 20, N. Y.

Circle No. 10 on Reply Card

Bubble Caps and Risers

PSC Light-Weight Processing and Heat Treating Equipment, Catalog 52, 24 pages of engineering data on 270 standard styles of bubble caps and risers for fractionating towers and stills; including drawings for use in determining methods of bubble tray assembly, as well as other process equipment. Pressed Steel Co., Wilkes-Barre, Penna.

Circle No. 11 on Reply Card

Valve Is Designed to Operate At 3000 psi, —40 to 225° F.

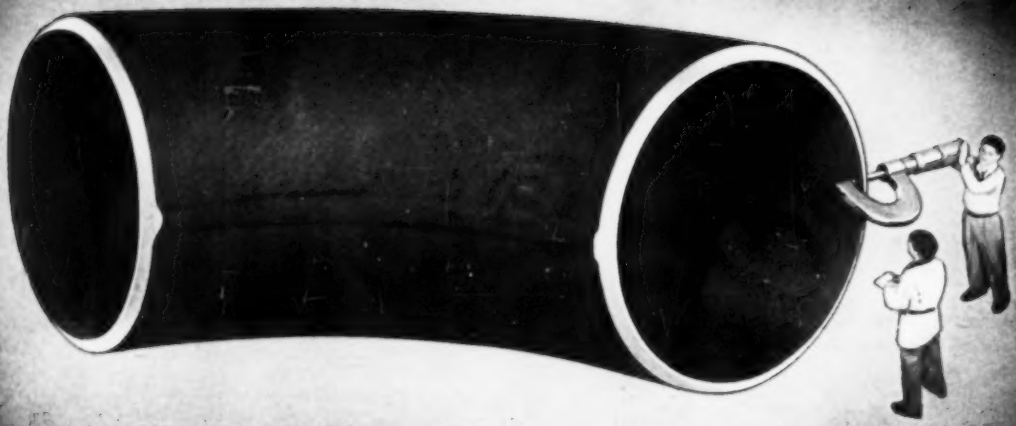
The new "Throttleseal" valve incorporates the use of "O" rings for positive shut-off. It has been designed for operation with fluids, gases, air, or vapor at up to 3000 psi., with temperature limits from —40 to +225° F. Its "Plug-Spindle" feature and micro-adjusting rising stem aids in the control of the ratio of the volumetric flow from fully open to less than 1% of effective flow area through the port. The metal seat retractable shield is an independent part and will not revolve when in contact with the seat. It encloses and protects the "O" rings when valve is operating. Valve is available in ¼ and ½-in. sizes, globe or angle type, and is made of stainless steel. Daniel Orifice Fitting Co., Los Angeles, Calif.

Circle No. 12 on Reply Card

"Cut-Out" Kits Provide for Easier Lab Lay-Out Planning

A unique and helpful idea in the form of "cut-outs" has been developed to assist the laboratory director in laying out his laboratory to attain high efficiency, space-wise. The cut-outs come in a kit providing the user with all the necessary scale-model "tools" for planning. Heights of assemblies can be allowed for as well as floor areas. The cut-outs represent 21 ready-made steel furniture units. They can be manipulated on the kit's graph paper. Utilities can also be marked on the plan and included as the furniture is laid out. Kit includes a complete catalog of equipment information. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Penna.

Circle No. 13 on Reply Card



REGARDLESS OF SIZE . . . they must have *Dimensional Accuracy*

This photographic fantasy is simply to emphasize the excep-
tional dimensional accuracy and uniformity of Midwest Welding
Fittings, thereby speeding and reducing piping costs.

MIDWEST
PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices: New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
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STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

9743

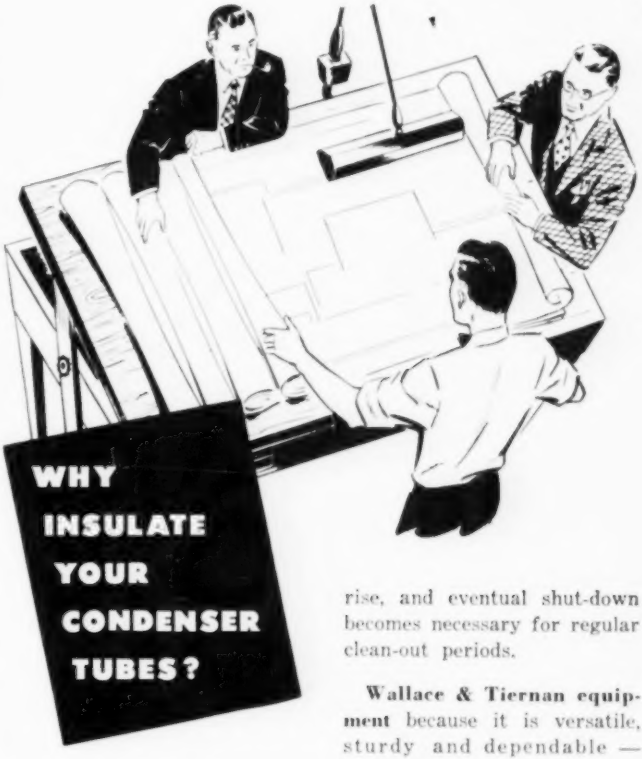
Chemical Mixing Tanks Use Floating Air-Sealed Covers

A line of Type 316 stainless steel mixing and storage tanks has an inverted air-seal cover which fits closely against the sides of the round tank and actually floats on top of its contents. This air-seal cover eliminates danger of contamination, evaporation and oxidation. Floating covers are made of a transparent, chemically inert resin, thus providing a visual check of tank contents at all times. By adding circulating pumps and jets to the tanks, vortex-free mixing of chemicals can be accomplished, and with the cover in place, air can be completely excluded during mixing operations. Tanks also have a machined, stainless steel, spring-closing spigot which dispenses liquids by flicking the handle downward. Supplied with a Neoprene "O" ring valve seal, spigot may be completely disassembled and assembled in a short space of time. Available in various sizes from 10 to 600 gals., the joints and seams of these tanks are flush. Heliare welded and passivated. Reco Sales Co., 70 East 45th St., New York, N. Y.

Circle No. **14** *on Reply Card*

Amyl Nitrate Additive for Diesel Fuels Made Available

Commercial availability of a new ignition improver for Diesel fuels, following a year-long test program with the U. S. Navy, has been announced by Ethyl Corp. Called Ignition Improver DB-36, the new additive is said to be designed to help refiners produce desired grades of Diesel fuel easily and economically. A mixture of primary amyl nitrates, the additive's test by Navy was in submarine service and it is now being checked out on railroad and highway service. Shipments will be made available in tank car and 55-gal.



You may be doing just that if your plans don't include CHLORINATION EQUIPMENT for slime control by WALLACE & TIERNAN.

Chlorination equipment because it controls slime that *grows* on the walls of condenser tubes not protected against it. Enough of the growth eventually seriously reduces heat transfer efficiency — actually *insulates* your steam from the cooling water. Back pressures go up, production drops, operating and maintenance costs rise, and eventual shut-down becomes necessary for regular clean-out periods.

Wallace & Tiernan equipment because it is versatile, sturdy and dependable — proven by thousands of successful installations, vouched for by satisfied users everywhere-and because there's a Wallace & Tiernan chlorinator for every job. Write today for information on how Wallace & Tiernan chlorination may help you solve *your* slime problem.

NO WATER IS SLIME-FREE

regardless of the source. Chlorination helps reduce slime in process or cooling water.

CD-37

WALLACE & TIERNAN COMPANY, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

(*To obtain more data on advertised products see page* 1840)

107,000 BBLS. OIL WASTE WATER TREATED DAILY BY SINGLE HARDINGE CLARIFIER

TOTAL COST--½ MILL PER BBL.

This 57' x 150' Hardinge Rectangular Clarifier, located in a west-coast refinery waste water disposal plant, is treating 107,000 barrels of waste water daily—removing the floating oil and solids at a total operating cost of one-half mill per barrel, or 0.0012 cents per gallon.

The influent contains 3 to 5 milliliters per liter of solids while the effluent tests show only two-tenths to four-tenths milliliters per liter of solids. Waste is treated with 25 to 45 p.p.m. aluminum sulphate and 5 to 9 p.p.m. activated silica.

Operating costs include labor, chemicals, repair, maintenance, taxes and utilities.

The Hardinge Clarifier has a traveling carriage which automatically scrapes accumulated solids into sludge hoppers at one end of the tank. The carriage also is provided with skimmers to remove floating oil from the water surface.

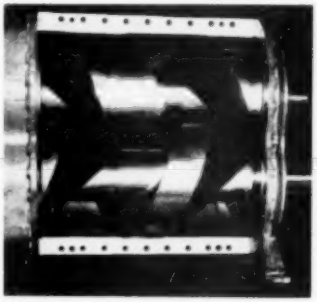
HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA—240 Arch St. Main Office and Works

NEW YORK 17 • SAN FRANCISCO 11 • CHICAGO 6 • HIBBING, MINN. • TORONTO 1
122 E. 42nd St. 24 California St. 205 W. Wacker Dr. 2016 First Ave. 200 Bay St.

drum quantities with distribution to be handled from both the East and West Coasts. Ethyl Corp., 100 Park Ave., New York 17, N. Y.

Circle No. **15** *on Reply Card*



Intermeshed Screw-Rotors Give Greater Compression Efficiency

The new "Spiraxial Compressor" has, instead of conventional rotors, two intermeshing screw-rotors arranged for rotation in opposite directions. To prevent contact, the screws are timed by a set of gears which allow close but very definite clearances between them. The rotors are formed along a spiral surface which is accurately generated to maintain proper clearances. There is also a close but very definite radial clearance between the rotating parts and the casing. This clearance is maintained by a re-entrant boss on each headplate, and is not dependent upon the use of dowel pins. There is no clearance between the inlet headplate and the screw-rotors. This permits rotors and casing to expand unequally without seizing. Flow of air or gas being compressed is axial with most of the compression taking place at the back of the casing. This allows an extremely large inlet opening, preventing strangulation of the inlet air, and increasing volumetric efficiency. Amount of internal compression is controlled by the design of the discharge port. When the compressor is built for a given discharge pressure, it can be operated without change of the port at a pressure approximately 3 to 5 psi above or below the original design, with little loss in efficiency. For differences in operating pressures of approximately 10 psi or more from original design, efficiency can be increased by changing the port. The compressor is designed for pressures of approximately 20 psi, capacity 1,115 cfm at 1,750 rpm and is driven by a direct-connected, squirrel-cage motor. Roots-Connersville Blower Corp., Connersville, Ind.

Circle No. **16** *on Reply Card*

Try ORBIT FORGED STEEL LP-GAS VALVES in your refinery where liquefied refinery gas is processed, stored and shipped. Orbit's welded bonnet construction, friction free seating principle and plastic packed stem make up a modern streamlined valve that is designed to match your modern processing techniques. Orbit offers very low maintenance costs and the maximum in safety.

Orbit Forged Steel LP-Gas Valves are offered in sizes beginning with 1" up to and including 4", ASA Class, Series 150 Lb. to 2500 Lb., 250° Fahrenheit maximum working temperature, carbon trim and stainless steel trim.

—Sold by Supply Stores—

BRANCHES

Houston, Texas
407 Velasco
(Serving the Gulf Coast)

Odessa, Texas
402 West County Road
(Serving West Texas)

Casper, Wyoming
1323 East "C" Street
(Serving the Rocky Mountain States and Canada)

ORBIT VALVE CO.

P. O. BOX 699 TULSA, OKLAHOMA

WANTED—TECHNICAL WRITER

We need a technically-trained man, under 35, for the editorial staff of PETROLEUM PROCESSING. He should have a background of mechanical engineering and experience in refining or petrochemical manufacturing operations—with emphasis on equipment. He should be able to write clearly and cleanly, and have done some work in preparing reports.

He should have an inquisitive mind and like to probe into the "why" of things, and be able to explain to others what he has found out.

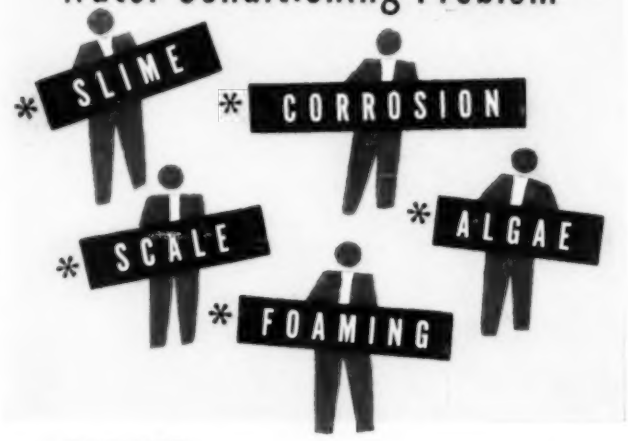
Experience in magazine or newspaper production is desirable but not essential.

Duties will include editing and rewriting copy, with responsibility for specific departments in the magazine, and field trips to gather data for original articles. Location is in Cleveland, and salary is open. Send details to:

EDITOR, PETROLEUM PROCESSING

1213 West Third Street • Cleveland 13, Ohio

EACH Had a Water Conditioning Problem*



EACH Found the Answer at Wright!

Wright never offers a "cure-all" . . . your water conditioning problems are individually studied and analyzed by our technical staff. The answer to each problem is contained in a complete personalized report prepared especially for you. After you adopt our recommendations, constant field and laboratory checks insure proper, economical performance. Write or call collect today for a complete survey of your individual water conditioning problems.

Wright CHEMICALS

Specializing in Water Conditioning

WRIGHT CHEMICAL CORPORATION

Offices in Principal Cities

Distributors of Nelson Chemical Proportioning Pumps and Refinite Softeners and Other External Treating Equipment

GENERAL OFFICES AND LABORATORY • 635 WEST LAKE STREET, CHICAGO 6, ILLINOIS

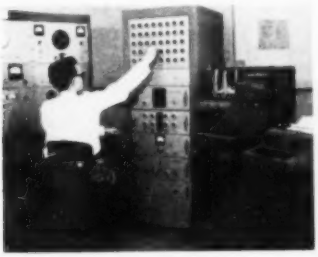
What's New!

Pneumatic Controls Position Cylinder-Operated Valves

Accurate positioning of cylinder-operated devices is the function of the newly-introduced "Poweractor" positioner. Operating from a standard 3-15 psi pneumatic controller signal, the positioner applies a high pressure, pneumatic differential across a cylinder piston, sufficient to produce the position demanded by the controller. Designed especially for use with the "Foxboro Stabiload Cylinder", the Poweractor unit will position equipment requiring long stroke and power, through pneumatic cylinder (or springless diaphragm) operating mechanisms. The positioner is a force balance type instrument, connected to the cylinder piston rod through a bracket and spring assembly. Every change in the controller signal produces a corresponding position change of the piston, and the positioner automatically returns to a null balanced condition. The Poweractor is capable of handling up to 150 psig. air supply, depending upon cylinder rating, and delivers, for example, 12 SCFM air flow with a 50 psig. supply. It responds to a change in signal pressure of ¼ of 1% of range and positions a piston within 1% of its total stroke under normal loading conditions. Direction of piston movement with respect to a signal pressure may be reversed by simply inverting the positioner. The Foxboro Co., Foxboro, Mass.

Circle No. **17** *on Reply Card*

What's New!



Computer Promises Speed-up in Routine Control Calculations

Designed to save time in data reduction and computation met in daily routine work for example in refining and petrochemicals where large numbers of very similar mixtures must be assayed the "Spectro-Sadic" is used in conjunction with the analytical mass spectrometer. It receives data from that instrument and converts it into digital form for automatic tabulation by an electric typewriter or an IBM computer. By so doing it eliminates the picking of individual peaks on graphical records and virtually eliminates chance for human error. Digital values of peak heights are available immediately after the scan. Only 10 seconds are required to scan a mass number and record its peak height. Forty peaks, for example, requires 6 minutes, 40 seconds, at the end of which time the peak-height figures may be read directly from the tabulation. Up to 40 mass numbers may be pre-selected and programmed by the instrument; peaks may be in the range of either mass 40 through 150 or from 12 through 122—and once adjusted the system is entirely automatic. Digital conversion is accurate to 1 in 1000, full-scale. Consolidated Engrg. Co., 300 North Sierra Madre Villa, Pasadena 8, Calif.

Circle No. 18 on Reply Card

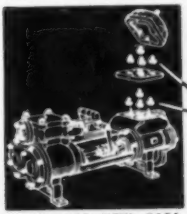
200-Amp. Safety Switch Meets NEMA Type 1-A Requisites

Immediate availability of a new 200-amp., 600-volt, fusible and no-fuse front-operated HCI (high capacity interrupter) safety switch has been announced. A felt gasket blocks dust and dirt, enabling the HCI standard enclosure to meet NEMA Type 1-A specifications. It is virtually free from direct openings to the interior. Most outstanding characteristic of the switch is its ability to interrupt heavy loads quickly and cleanly. The arc-quenching action is patterned after the arc-interrupting principle of modern circuit breakers. Double-break, visible contacts are projected and withdrawn with piston-like speed and force. Grid pins

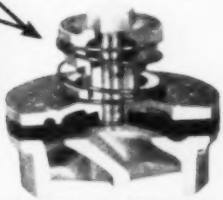
BETTER PUMP PERFORMANCE MEANS *Less Maintenance*

SIMS PUMP

Sims Pump Valves are guaranteed to give you better pump performance. And that means time, money and tempers saved.



1. Discs rotate for minimum wear while cushioned by liquid top and bottom. 2. Inclined ribbed seat and cushioned stem head combine to give smoother, faster valve action and take up shock.

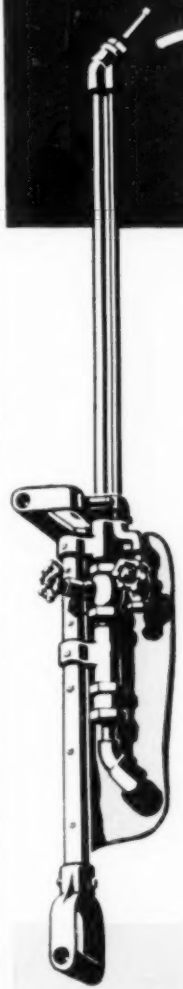


WRITE FOR NEW CATALOG showing how Sims Valves fit your pump for better performance.

VALVE CO., INC.

145 HUDSON ST., NEW YORK 13, N. Y. • M & M BLDG., HOUSTON, TEXAS

BLAST equipment clean in half the time



This dirt-dynamiter cleans and rinses at the twist of a valve—no more hand-scraping, scrubbing, brushing.

The Oakite 481 Solution-Lifting Gun hits soil with heat, force, powerful Oakite detergent. Breaks up, floats off even the heaviest soils, no matter how hard to reach. Lifts cleaning spray up to 12 feet above working level.

Light, easy to operate, gun is equipped with rubber safety apron, insulated handles, and swivel to prevent twisting of lines. No pumps, injectors, motors needed—just rubber hose, solution container, 30 lbs. of steam.

Hook it up to your snuffer lines and you're ready to clean up around processing units, docks, salvage areas, garages, power houses, pipe stills, decks, gridwalks, etc.

Try it yourself. Ask your local Oakite Technical Service Representative. Or write Oakite Products, Inc., 44C Rector St., N. Y. 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

MATERIALS • METHODS • SERVICE

Technical Service Representatives in Principal Cities of U. S. & Canada

Why Most Pipe Fitters Buy RIDGID Pipe Wrenches

Guaranteed RIDGID wrench housing saves you repair trouble and expense

It's an extra fast easy wrench to work with, too—handy pipe scale on hookjaw, adjusting nut spins easily to pipe size, comfort-grip handle.

Special alloy jaws both replaceable—won't slip or lock on pipe.

Safe powerful malleable housing and I-beam handle.

Save money, make work easier—buy RIDGID, world's most popular pipe wrench, at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RIDGID
Work-Saver Pipe Tools

break up the arc, divide it into a series of smaller arcs, and dissipate the heat, so contacts don't pit and last considerably longer. General Electric Co., Trumbull Electric Dept., Plainville, Conn.

Circle No. **19** *on Reply Card*

Trade Literature

Ethylbenzene Information

Ethylbenzene, Technical Data Report TX-12; twelve pages of chemical, physical, and reaction data on this aromatic hydrocarbon, a water white liquid boiling at 136° C.; typical reactions including oxidation, nitration, sulfonation, hydrogenation, dehydrogenation, halogenation alkylation, and acylation. Monsanto Chemical Co., Texas Div., Texas City, Texas.

Circle No. **20** *on Reply Card*

Heat Exchanger Service Center

Alco Products Review, Fall, 1952; includes a seven-page article describing a new service center for maintenance and repairs on heat exchangers in the Southwest, at Beaumont, centering among some 48 refineries, 87 natural gasoline and cycling plants and 50 chemical plants; also a shorter article on aircoolers at Celanese's new plant at Pampa, Texas. Alco Products Div., American Locomotive Co., Dunkirk, N. Y.

Circle No. **21** *on Reply Card*

Circuit Breaker Manual

What You Should Know About Circuit Breakers, Manual 101; 16 pages explaining operating principles of basic circuit breaker designs with engineering data on applications; includes simplified diagrams of three basic type circuit breakers in general use today. Heinemann Electric Co., 365 Plum St., Trenton 2, N. J.

Circle No. **22** *on Reply Card*

Handling Volatile Fluids

Vertical Pumps for Volatile Fluids, Bulletin 1026; six-page folder gives the design advantages of vertical turbine pumps for handling gasoline, diesel fuel, ammonia and other volatile liquids; includes cross-sectional drawings with explanatory installational features. Johnston Pump Co., 3272 E. Foothill Blvd., Pasadena 8, Calif.

Circle No. **23** *on Reply Card*

Concrete Storage Tanks

First Consideration in Storing Liquids; a six-page brochure describing a new sliding-form technique for constructing concrete storage tanks in which the project elevates itself progressively as the walls go up. Concrete Storage, Inc., 30 Vesey St., New York City.

Circle No. **24** *on Reply Card*

What's New!

Acrilan Process

"*Acrilan: A New Industry*," a six-page article appearing in the October 1952 issue of *Heat Engineering*, describing the process which will be employed at the nearly completed plant of the Chemstrand Corp. in Decatur, Ala., for the production of 30 million lbs./year of "Acrilan"; gives a description of three newly-installed steam generating units which will provide process steam to the new plant. Foster Wheeler Corp., 165 Broadway, New York 6, N. Y.

Circle No. **25** *on Reply Card*

An Equation Solver

Ease Computer, Data File 309-23, 12-page brochure describes applications, methods and features of the "EASE" analog computer which functions as an equation solver, simulator or tester. Beckman Instruments Inc., South Pasadena 1, Calif.

Circle No. **26** *on Reply Card*

Corrosion Proof Surfacing

Celcrete, Corrosion Proof Surface Material, Bulletin 110, six-page folder describes a protective surfacing material which can be applied to walls and floors where it will withstand trucking, foot traffic, and erosion from hot solutions, solvents, alkalies, acids, and steam. The Celcote Co., 4832 Ridge Rd., Cleveland 9, Ohio.

Circle No. **27** *on Reply Card*

Instrumentation

Instrumentality, 27 bulletins make up this catalog folder which covers all instruments made by Wheelco for measuring, controlling and recording temperature, voltage, current, static strains and many other variables in industrial processing; includes prices. Wheelco Instruments Co., Harrison and Peoria Sts., Chicago 7, Ill.

Circle No. **28** *on Reply Card*

Centrifugal Pumps

Pacific Precision Built Centrifugal Pumps, Bulletin 1-A, four-page folder gives specifications on 17 types of single and or multi-stage centrifugal pumps, 6 oil well plunger pumps, 2 turbo boiler-feed pumps with speeds up to 10,000 rpm., and 3 single and multi-stage vertical centrifugal pumps. Pacific Pumps, Inc., Huntington Park, Calif.

Circle No. **29** *on Reply Card*

Analog-to-Digital Converter

Type 33-102 Sadic and Associated Equipment, Bulletin 3002, 12 pages of engineering information and descriptive data on a system which, for example, will convert simultaneously four analog measurements to numerical form, punch automatically the values on standard cards and type in tabular form; or with a special unit also plot any two selected values against each other in analog chart

ENGINEERED Foam Fire Protection

FIRE-TESTED **CUSTOM-DESIGNED**

Are your fire-fighting facilities in step with your flammable liquid hazards? They are, if the fire-tested protection of National Foam products has been "engineered" to your specific needs.

If gasoline, alcohols, acetone or mixed polar solvents are used or stored in your plant, you need the fast, positive, automatic smothering action of foam—the *right* type of foam, at the *right* places, in the *right* amounts, at the *right* time.

That's what we mean by Engineered Foam Fire Protection. Large plant or small, National Foam engineers are equipped by years of training and experience to study your plant's risks, determine the type of foam needed—whether mechanical or chemical—and recommend, from the widest available choices, exactly the right types of National Foam devices to give you complete protection.

Your nearest National Foam Distributor will be glad to help you, or write us direct about your fire protection problem.

NATIONAL
FOAM SYSTEM, INC.
Headquarters for Foam Fire Protection
WEST CHESTER, PENNA.

form. Consolidated Engrg. Corp., 300 North Sierra Madre Villa, Pasadena 8, Calif.

Circle No. **30** *on Reply Card*

Rotary Pump Manual

Installation, Operation, Maintenance of Warren Quimby Pumps. Bulletin 100-2; 12-page brochure covers installation, operation and maintenance of rotary pumps with discussion of installing foundation bolts, alignment, supporting vertical pumps, grouting, piping, suction lines, hot liquid pumps, rotation, packing, dismantling, reassembly, starting, operation and standing idle; includes charts and sectional elevation drawings. Warren Steam Pump Co., Inc., Warren, Mass.

Circle No. **31** *on Reply Card*

Anti-Corrosion Coatings

Tygon Paint, Bulletin No. 730; 16-page booklet with a full description of "Tygon" paint, plus information on "Tygorust", a new vinyl primer, both corrosion-resistant coatings; includes instructions on where and when to use the coatings; comprehensive chemical-resistance charts, and an extensive chart on recommended primers and surface treatments. U. S. Stoneware Co., Akron 9, Ohio.

Circle No. **32** *on Reply Card*

Properties of Organics

Physical Properties of Synthetic Organic Chemicals, 1953 Edition, Booklet F-6136; 20-page booklet including a section on 56 new research chemicals and data on more than 320 products; physical properties are given in tabular form and chemicals are arranged by family groups with data on applications. Carbide and Carbon Chemicals Co., A Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

Circle No. **33** *on Reply Card*

Expansion Joint Design Guide

Design Guide for the Application and Selection of Corrugated Expansion Joints, Bulletin CMH-127R; 16-page illustrated catalog describing all types of corrugated expansion joints, low and high pressure types, and basic theory behind expansion joint design; includes complete specifications and installation data for a redesigned line. Flexonics Corp., 1382 So. Third Ave., Maywood, Ill.

Circle No. **34** *on Reply Card*

Petroleum Processing Index

PETROLEUM PROCESSING *Index for 1952*; includes subject and author indexes for all feature articles and regular departments for the 12 issues of this magazine published during 1952; available in about three weeks. Platt's Petroleum Publications, 1213 West Third St., Cleveland 13, Ohio.

Circle No. **35** *on Reply Card*

Lubricants—1902-1952

Lubrication, December, 1952; devotes all 16 pages to a brief historical review of developments in the field of lubricants for the last 50 years. The Texas Co., 135 East 42nd St., New York 17, N. Y.

Circle No. **36** *on Reply Card*

Glass-Lined Steel

The Surprising Structural Strength of Glass Fused to Steel; Bulletin 892; eight pages covering the advantages of glass-lining on steel, repair techniques, etc. The Pfaudler Co., Rochester 3, N. Y.

Circle No. **37** *on Reply Card*

Automatic Electric Relays

Relays for Industry, Circular 1702-A; 12-page brochure covering a complete line of telephone-type electric relays, including hermetically sealed sub-miniature, plug-in types; assembly relay parts are listed in the "how-to-order" section. Automatic Electric Sales Corp., 1033 W. Van Buren St., Chicago 7, Ill.

Circle No. **38** *on Reply Card*

Corrosion — AN ALLY OF THE ENEMY

CORROSION — the great saboteur — works night and day making old storage tanks useless and necessitating costly repairs to new. In some sour crude areas, new tanks have been rendered useless in as little as 18 months.

Now, with steel again in short supply, you will have to get the maximum years of life from each tank so there may be more steel for defense.

NATASCO products will prevent corrosion from getting a start on your new tanks and prevent further corrosion on old ones.

NATASCO corrosion prevention products have been proved by years of successful use. NATASCO also provides experienced crews for the preparation and application of these products.

CONTRACT SERVICES:
Tank Welding Repairs and Maintenance
Installation of Tank Appurtenances
Tank Painting
Application of Protective Coatings
Tank Cleaning — BS&W Emulsion Chemical Treating

Learn how you can get the most in years of additional service from your tankage. Wire, telephone or write for complete information.

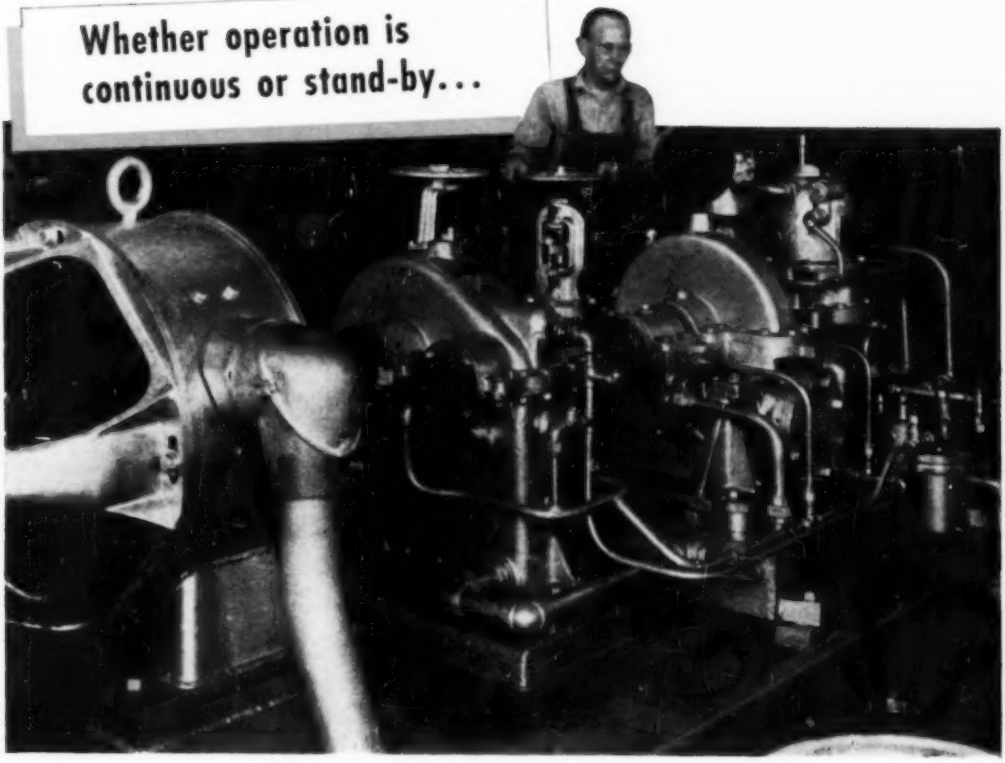
The Natasco Company
P. O. BOX 1318 TULSA, OKLAHOMA

Lease Tank Service—West Texas Area:
Williams Construction Co.
Odessa, Texas

California Representative:
Coast Contractors, Inc.
2627 Atlantic Ave.
Long Beach 6, Calif.

New England Representative:
The McKin Company
P. O. Box 711
Portland, Maine

Whether operation is continuous or stand-by...



TYPE E turbines can handle it!

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Of this installation, both the Chief Engineer and the Chief Power Plant Operating Engineer stated, "We are impressed by the design, appearance, and smooth-running qualities of the Type E turbine, and also the unique design of the oil-relay governor and forced-feed lubrication which the Type E provides." This all-Westinghouse end of Schrafft's power plant includes a new 1000-kw Westinghouse Geared Turbine-Generator, served by existing Westinghouse switchboard equipment and motor-generator sets.

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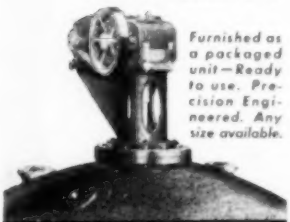

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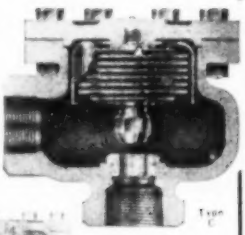
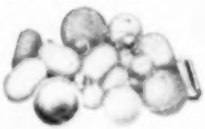
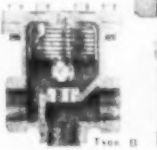


Type C



Type A



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What's New!

Corrosion Fighter

Hercules Polyrad 1110A as a Corrosion Inhibitor and Detergent in Petroleum Refining Equipment. Bulletin 189, five pages of technical data on a polyoxyalkylene derivative of a primary rosin amine, designed for combatting corrosion in heat exchangers, fractionators, etc., by injection into the process stream. Hercules Powder Co., Wilmington 99, Del.

Circle No. **39** *on Reply Card*

Instrumentation

Electronik Recorders, Indicators. Catalog 1520, 44-page bulletin describes accurate ultra-high-speed recording and indicating instruments with detailed specifications and information on strip chart recorders, circular chart recorders, precision indicators, measuring elements, analytical apparatus, basic measuring circuits, charts and scales. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

Circle No. **40** *on Reply Card*

Information Offered in The Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data offered in this issue's advertisements:

ACETYLENE, from hydrocarbons. Information on the Wulff Process offered by The Pfaudler Corp. See adv't p. 1762.

ACTIVATED ALUMINA, for drying propane. Information offered by Aluminum Co. of America. See adv't p. 1801.

ADDITIVES, for industrial use; santolube 70. Technical bulletin No. 0-56 offered by Monsanto Chemical Co. See adv't p. 1705.

AIR PREHEATERS. Complete details offered by The Air Preheater Corp. See adv't pp. 1712-1713.

ALLOYS, bar stock. Information offered by Haynes Stellite Co. See adv't p. 1752.

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

ALLOYS: nickel, for high temperature service. High Temperature Work Sheet offered by The International Nickel Co., Inc. See adv't p. 1834.

ANTI-FOAM AGENTS: for carryover and boil-down control. Technical Paper No. 115 offered by W. H. & L. D. Betz. See adv't p. 1742.

BLENDERS: automatic. Descriptive literature and recommendations offered by G. Pappermaster, Inc. See adv't (inside front cover).

BOLTS: for high temperature and pressure. Full information offered by Bethlehem Steel Co. See adv't p. 1741.

CATALYSTS: cracking, microspheroidal. Descriptive information offered by The Davison Chemical Corp. See adv't pps. 1704-1705.

CHLORINATION EQUIPMENT: Information offered by Wallace & Tiernan Co. See adv't p. 1846.

COMPRESSORS: centrifugal. Book "Centrifugal Compressors for Industry" offered by Carrier Corp. See adv't p. 1734.

COMPRESSORS: gas. Bulletin 1-600-BIR offered by Worthington Corp. See adv't p. 1740.

CONDENSERS: vertical, Flo-type. Complete information offered by The Griscom-Russell Co. See adv't p. 1746.

CYCLOVERSION: process. Information offered by Phillips Petroleum Co. See adv't p. 1710.

DRYERS: for air, gas and organic liquids. Information offered by Pittsburgh-Lectrodryer Corp. See adv't p. 1735.

ELECTRICAL DISTRIBUTION: systems. Information offered by General Electric Co. See adv't pps. 1559-1560.

ENGINEERING CONSULTING SERVICE: Brochure PP 16-1 offered by Arthur D. Little, Inc. See adv't p. 1748.

EQUIPMENT CLEANING: device, "dirt-dynamiter." Trial offer made by Oakite Products, Inc. See adv't p. 1743.

FIRE PROTECTION: air foam type. Complete information offered by Pyrene Manufacturing Co. See adv't p. 1818.

FIRE PROTECTION: foam systems. Helpful information offered by National Foam System, Inc. See adv't p. 1851.

FLOATING ROOFS: triple seal. Bulletin offered by General American Transportation Corp. See adv't p. 1698.

FLOATS: high pressure. Bulletin 630 offered by W. H. Nicholson & Co. See adv't p. 1854.

FLOW CONTROLLERS: pneumatic. Bulletin H-11 offered by Consolidated Corp. See adv't p. 1855.

FLOW RATIO CONTROLLER: Catalog F-30 offered by Fischer & Porter Co. See adv't p. 1708.

FRACTIONATION: Know how on fractionating problems offered by Koch Engineering Co., Inc. See adv't p. 1718.

GASOLINE TREATING: metal deactivator for copper contamination. Information offered by E. I. DuPont de Nemours & Co., Inc. See adv't p. 1816.

HEAT EXCHANGERS: air-cooled. Information offered by The Marley Co. See adv't facing pps. 1729-1730.

HEAT TRANSFER MEDIUM: "Dowtherm series" offered by The Dow Chemical Co. See adv't p. 1714.

LIQUID LEVEL GAGES: tank, automatic. Full information offered by The Valley Industry Systems Co. See adv't p. 1815.

METAL BANDS AND WIRE: for installing. Information and prices offered by Acme Metal Wire Co. See adv't p. 1825.

MIST ELIMINATORS: Bulletin giving detailed information offered by Metal Textile Corp. See adv't p. 1709.

OXYGEN-NITROGEN GENERATORS: Catalog offered by Air Products, Inc. See adv't p. 1720.

PAINT: rust preventive. Complete literature offered by Bell-Mar-Hoover Corp. See adv't p. 1747.

PETROCHEMICALS PROCESSING: for upgrading refinery by-products. Information offered by The M. W. Kellogg Co. See adv't pps. 1726-1727.

PROCESS EQUIPMENT: pressure vessels, heat exchangers, filters, piping. Information offered by American Locomotive Co. See adv't p. 1733.

PUMPS: rotary, positive displacement type. Facts booklet offered by Blackmer Pump Co. See adv't p. 1825.

RECORDER: oxygen. Bulletin 51-52B offered by The Hays Corp. See adv't p. 1754.

REFINERY ENGINEERING SERVICE: Brochure offered by Refinery Engineering Co. See adv't p. 1824.

REFINERY EQUIPMENT: cleaning. Illustrated booklet offered by Dowell Inc. See adv't p. 1737.

REFRACTORIES: porous medium. Bulletin No. 140 offered by Norton Co. See adv't p. 1717.

REFRACTORY LININGS: Brochure RC-28A offered by Johns-Manville. See adv't p. 1822.

SAFETY HEADS: Catalog offered by Black, Sivalls & Bryson, Inc. See adv't p. 1852.

STEAM TRAPS: Bulletin 102 offered by W. H. Nicholson & Co. See adv't p. 1854.

TANKS: cleaning, repairs and corrosion protection. Complete information offered by The Nelson Co. See adv't p. 1852.

TUBING: aluminum, small diameter. Booklet entitled "Ultrube" offered by The Aluminum Co. of America. See adv't p. 1828.

TUBING: heat exchanger and condenser, copper alloy. Case histories offered by The American Brass Co. See adv't p. 1722.

TURBINES: general purpose. Information offered by Westinghouse Electric Corp. See adv't p. 1850.

TURBINES: steam. Full details and specifications offered by Dean Bros. Pump Co. See adv't p. 1726.

VALVES: butterfly. Valve catalog offered by W. S. Rockwell Co. See adv't p. 1819.

VALVES: control. Bulletin 700-2 offered by Minneapolis-Honeywell Regulator Co. See adv't p. 1840.

VALVES: control. Catalog 1500B offered by The Annin Co. See adv't p. 1726.

VALVES & FITTINGS: for LPG piping. Circular AT-1804 offered by Crane Co. See adv't p. 1757.

VALVES: for pumps. New catalog offered by Rome Pump Valve Co., Inc. See adv't p. 1849.

VALVES: lubrication. Data offered by Rockwell Manufacturing Co. See adv't p. 1742.

VALVES: plug, non-lubricated. Catalog No. 52W offered by Westeeling Valve Co., Inc. See adv't p. 1750.

WASTE HEAT BOILERS: Information offered by Allied Chemical & Dye Corp. See adv't p. 1739.

WELDED FITTINGS: Catalog W3 offered by Bonney Forge & Tool Works. See adv't p. 1716.

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EDITORIALS

How Deep, the Roots of Bureaucracy?

SPEAKING before the recent American Petroleum Institute meeting in Chicago on the subject of the petroleum reserves needed for our national security, Secretary of the Interior Chapman said:

"Yet I know as you do that eventually—eventually the present profit incentive alone may prove inadequate to produce the results we must have. Somewhere we are going to have to find something else to help do the job, some adjustment perhaps, some new technique—something.

"A reserve after all is by definition something designed to be available beyond the demands of present consumption and so there must be some kind of extra inducement to insure its maintenance."

Mr. Chapman's remarks on the coming inadequacy of the free petroleum industry to measure up to the nation's needs cannot be dismissed lightly because his tenure in office and that of the administration he represents is coming to an end. The Secretary personally has expressed much higher regard for the oil companies than is held in many offices in Washington. He will leave in many important posts in the Interior Department, men who are thoroughly imbued with the philosophy of extending government control in the petroleum and gas industries and other natural resources. If Secretary Chapman himself believes that in the future the profit incentive from free enterprise will not be sufficient to guarantee the nation's needs for petroleum will be met, we may be certain that similar and even more radical views are held in some of the agencies and bureaus of the Interior Department in Washington and over the country.

The Secretary, in his Chicago address, paid a real tribute to the petroleum industry for its accomplishments in two wars and its part in the nation's present preparedness program. What other force than the natural law of supply and demand does he foresee as being better able in the future to direct the tide of industry expansion and the development of our petroleum and gas resources? What will take the place of profit incentive? What could it be other than some form of bureaucratic control and direction, perhaps even government subsidy or ownership of enterprises in the new fields of producing liquid fuels from oil shale and coal?

The powers of some of the bureaus in the Interior Department have been greatly extended over the past 20 years. Its Bureau of Reclamation is in direct competition with the private power companies. This agency develops, distributes and sells electric power at below cost to drive out private competition in some states. It uses public funds in its propaganda campaign against private industry. In the Bureau of Mines synthetic liquid fuels study, a share of the millions appropriated by Congress for research work have been spent in propaganda on behalf of government subsidized commercial plants to make oil from shale and coal, in competition with the oil companies.

The roots of bureaucracy have already sunk deep in some of the activities of the Interior Department. Merely changing the cabinet officer for this government department is not going to stop the efforts of these bureaus for more power and authority. The petroleum and other industries must vigilantly continue their fight against further encroachment by the bureaucrats under the guise of protecting the public interest in our natural resources. —V.B.G.

Standards for Underground Storage

THE NATURAL Gasoline Assn. of America has taken a forward-looking step in the preparation of tentative safety standards for storing LP-Gas underground in wells and caverns. In adopting them in final form late last October, the association has anticipated needs of regulatory bodies and insurance companies in preparing regulations for storing these materials in the earth.

The is little room for doubt that, in the absence of experience and actual data on the subject, these authorities might inadvertently impose unnecessarily cumbersome and costly requirements on the industry. Perhaps unfamiliarity with the subject might well invite the very disaster these bodies would seek to prevent.

These tentative standards actually involve no more than recognized engineering practice in the industry. In preparing them NGAA drew heavily on the experience and data possessed by its member-companies. A special committee was formed on a permanent basis to prepare the standards and make such future revisions as circumstances may indicate are needed from time to time.

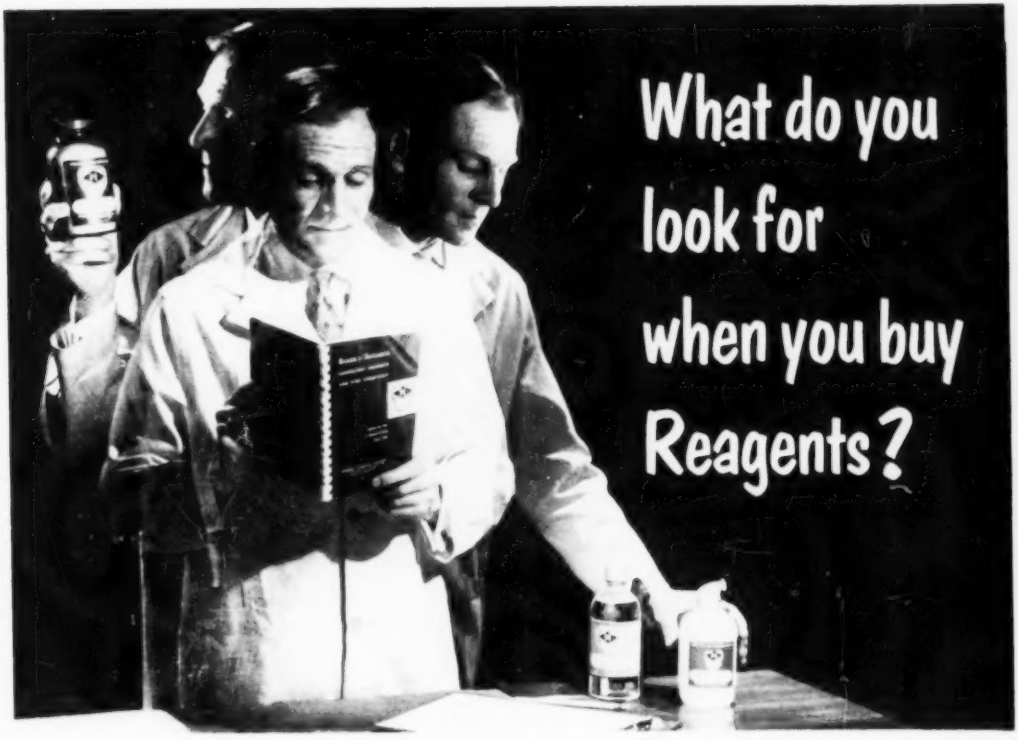
Another commendable function of this committee will be to work with regulatory bodies upon request —whenever their services may be helpful. This should be made use of by these organizations. A wealth of experience, engineering data and research are available for the asking; information which could not be duplicated elsewhere without great expenditure of time and money.

That these standards were not prepared without careful consideration may be inferred from the fact that they already have been applied—successfully —in the storage of large volumes of temporarily excess production of valuable products. NGAA is to be commended for its public service in preparing these standards. —D.P.T.

The $64-Million Question

SPEAKING before the California Natural Gasoline Assn., David E. Day, Richfield Oil Corp. of California, said most of the things we consider new in refining technology really are basically old. There has been no revolution in technology, but rather a slow but steady improvement in refinery engineering, equipment and construction materials.

For many years, he said, refiners could set aside from earnings most of the capital needed to replace their obsolete equipment. Today, after profit, taxes and a return to investors, few companies have enough left over to buy the new tools for refining. The most important refining development problem today has passed to the front office, to figure out how to borrow needed funds at the lowest cost. —V.B.G.



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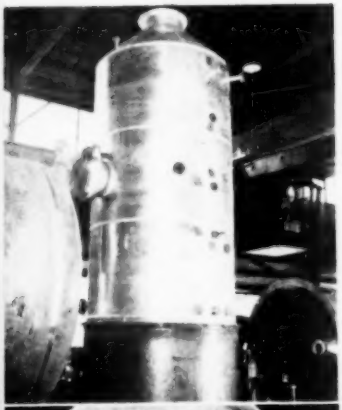

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